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THESIS

**OPTIMIZING FIRE DEPARTMENT OPERATIONS
THROUGH WORK SCHEDULE ANALYSIS,
ALTERNATIVE STAFFING, AND NONPRODUCTIVE
TIME REDUCTION**

by

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September 2014

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**OPTIMIZING FIRE DEPARTMENT OPERATIONS THROUGH WORK
SCHEDULE ANALYSIS, ALTERNATIVE STAFFING, AND NONPRODUCTIVE
TIME REDUCTION**

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ABSTRACT

This thesis conducts a policy analysis exploring how current fire department policies can be modified to optimize employee availability to lead to higher staffing levels and lower sick leave and injury leave usage. Work schedule modification, alternative staffing models, and the reduction of nonproductive time through health and wellness initiatives are the three options examined in this thesis by using data from the Dayton (Ohio) Fire Department. The findings of this research are that schedule modification and the reduction of nonproductive time by initiating wellness programs may increase employee availability; alternative work schedules tended to increase injury rates and the potential for political and legal conflict. These findings should be applicable to fire departments across the country, most of whom address the same budget shortfalls and force-strength challenges.

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LIST OF ACRONYMS AND ABBREVIATIONS

ALS	advanced life support
BAC	blood-alcohol content
BLS	basic life support
CBA	collective bargaining agreement
CMO	City Manager's Office
CVD	cardiovascular disease
DFD	Dayton Fire Department
DOL	Department of Labor
EDO	earned day off
EMS	emergency medical services
FLSA	Federal Labor Standards Act
GM	General Motors
HIPAA	Health Information Portability and Accountability Act
IAFC	International Association of Fire Chiefs
IAFF	International Association of Firefighters
IDLH	immediately dangerous to life and health
ISU	Incident Support Unit
NCR	National Cash Register
NFPA	National Fire Protection Association
NIST	National Institute for Standards and Technology
OSHA	Occupational Safety and Health Administration
ROI	return on investment
WFI	wellness-fitness initiatives

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EXECUTIVE SUMMARY

Fire departments are struggling with budget reductions; over one half of all fire departments across the United States believe they lack adequate funding to maintain current operations. Cities such as Dayton, Ohio, have experienced reductions in revenues that have resulted in corresponding budget cuts to the fire department. Work schedules, staffing inflexibility, and the health and wellness of their personnel impacts employee availability and may lead to reduced service levels. Work schedules affect the health and emotional condition of employees that eventually impact their fitness for duty leading to increased sick and injury leave occurrences. Closely associated with the work schedules, firefighter health and wellness can be impacted by the lack of rest and may lead to injuries. Finally, staffing inflexibility because of minimum staffing regulations may limit the number of apparatus that can be put into service each day.

All these factors inhibit fire management's ability to maintain current and past levels of fire services without an increase to their operating budget. Therefore, this begs the question on whether fire departments can optimize their service delivery by increasing employee availability through policy alternatives, such as schedule modifications, alternative staffing models, or reductions in nonproductive time. Also, given these options, can any one option or combination thereof optimize fire service delivery while still being cost effective, legal, politically acceptable, efficient, and effective?

This thesis conducts a policy analysis exploring how current fire department policies can be modified to optimize employee availability to result in higher staffing levels and lower sick and injury leave usage. Using data from the Dayton Fire Department (DFD), work schedule modification, alternative staffing models, and the reduction of nonproductive time through health and wellness initiatives, are the three options examined and compared against status quo policies.

A. STATUS QUO POLICY

1. Work Schedule

The DFD currently employs a 24/48 work schedule where a 24-hour work shift is followed by 48 continuous hours of off-duty time. This schedule is commonly used by many fire departments across the nation to provide continual fire protection to the public.

2. Staffing Model

The DFD employs a four-person staffing model on its fire apparatus. This policy offers immediate compliance with Occupational Safety and Health Administration's (OSHA) two-in/two-out rule, performs the 22 essential firefighting tasks at low-risk residential structure fires 25% faster than a three-person crew, and meets National Fire Protection Association (NFPA) 1710's recommendation of having 15 firefighters available at single-alarm fire scenes.

3. Health and Wellness Program

The DFD provides pulmonary function testing to its employees to assess their ability to function as a firefighter wearing a breathing respirator. It has limited health and wellness applicability and meets OSHA's annual respiratory function testing requirement; it also provides medical testing to at-risk employees. Early detection during pulmonary function testing mitigates absences, and therefore, effectively increases the number of available personnel each day.

B. SCHEDULE MODIFICATION

Similar to the 24/48 schedule currently employed by the DFD, a 48/96 schedule is similar in structure, with both possessing a 1:2 duty to off-duty ratio. Weekly work hours and the number of personnel needed are unchanged.

Research suggests that the 48/96 schedule may decrease sick and injury leave usage, potentially lowering overtime costs below current levels. As leave usage decreases, more personnel are available to staff additional apparatus, or to staff the same number of apparatus without using overtime personnel.

Changing to the 48/96 schedule also benefits the employees. Increasing their off-duty time from 48 hours to 96 hours increases their ability to engage with their families and to catch up with their rest before returning to duty. It has also effective in recovering from emotional, mental, and physical stressors related to working 48 straight hours. Literature suggests that these factors and higher morale have been correlated to lower sick and injury leave usage, and thus, improve personnel availability.

1. Alternative Staffing

The DFD currently employs a four-person staffing model on all its fire apparatus. However, three-person staffing offers many benefits to the organization otherwise unattainable under the current staffing model. The number of staffed apparatus each day is reliant upon the number of available personnel. Having the capability to staff fire apparatus with three persons may offer opportunities to redistribute personnel to staff more resources, which enhances response redundancy. It also boosts the flexibility to staff apparatus as needed to address peak run volume and fire severity periods. On the other hand, literature suggests that three-person staffing may increase injury leave rates and also compromise crew efficiency and effectiveness.

2. Nonproductive Time Reductions through Health and Wellness Initiatives

Wellness programs may reduce nonproductive time that will enhance fire service delivery by increasing employee availability, and subsequently, staffing additional fire apparatus. Wellness programs may be effective in early detection of significant health conditions and reducing nonproductive time, such as sick and injury leave. Employees also benefit from these programs because early detection of a life altering health condition may improve the employee's quality of life, and with rehabilitation services, may even result in the employee's return to duty.

Wellness programs have also been shown to be cost efficient. Although the start-up costs can be daunting, its return-on-investment may potentially pay for itself in subsequent years. A wellness program may minimize the frequency and duration of

employee absences and reduces dependency on backfill overtime coverage. Wellness programs may also reduce health care and workers' compensation costs.

The findings of this research is that schedule modification and the reduction of nonproductive time by initiating wellness programs may increase employee availability; alternative work schedules tended to increase injury rates and the potential for political and legal conflict. Increasing employee availability optimizes fire department operations; thereby, increasing operational capability without a corresponding increase in operating budgets. These findings should be applicable to fire departments across the country, most of whom address the same budget shortfalls and force strength challenges as the DFD.

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I. INTRODUCTION

A. PROBLEM STATEMENT

Located on 55.65 square miles of land in southwest Ohio, Dayton was a “boomtown” during the 1960s and 1970s, with major corporations, such as General Motors (GM), National Cash Register (NCR), Dayton Tire and Rubber Company, and Mead Corporation, locating their headquarters and multiple plants within the city limits. Since then, these corporations have gone out of business or were “bought out” by other corporations that subsequently closed the plants and moved their headquarters out of Dayton. This reduction resulted in lost jobs and a significant amount of citizens who had to relocate to seek employment. Dayton’s population declined from a high of over 200,000 residents to the current population of just over 141,000 people.¹ With corporate and income taxes being its primary revenue generators, the City of Dayton had to make adjustments to its operational model that resulted in budgetary reductions for all its operating departments, including the Dayton Fire Department (DFD).

To accommodate the budget reductions, the DFD has reduced its daily apparatus and personnel complement by 40% over the past 20 years. Twenty fire apparatus used to be staffed on a daily basis, which has now been cut to twelve. Unfortunately, the DFD’s annual response requests have not declined proportionally to the apparatus reductions. The public, often failing to have primary care physicians, used local emergency room services as their means for medical care and often DFD emergency medical services (EMS) were called for medical transport. In fact, emergency dispatches have increased from 26,000 runs per year in 1989 to 32,000 runs per year in 2012 with EMS runs comprising of 80% of the increase.² Further aggravating the problem is the exodus of over 70,000 residents, which has left a glut of vacant homes to be targeted by arsonists.³

¹ U.S. Census Bureau, “State & County QuickFacts,” accessed July 8, 2013, <http://quickfacts.census.gov/qfd/states/39000.html>.

² City of Dayton, *2012 Year-End Report* (Dayton, OH: City of Dayton, 2012).

³ Ashley Lutz, “Ohio’s Dayton, ‘Once Full of Families,’ Has 21% of Houses Empty,” *Bloomberg*, March 9, 2011, <http://www.bloomberg.com/news/2011-03-10/ohio-s-dayton-once-full-of-families-has-21-of-houses-empty.html>.

A review of the applicable research suggests that the DFD is a microcosm of an industry-wide problem in which fire departments across the country have seen their operating budgets cut because of fiscal crisis. Over one half of the fire departments across the United States (U.S.) believe that they are underfunded.⁴ In addition to the DFD, other fire departments in other cities, such as San Jose, Jacksonville, Newark, and San Diego, have experienced budget-cutting measures.⁵ While operating budgets continue to fall, the request for service by the public may not, and in Dayton's case, may even rise as the public continues to use DFD EMS and local emergency rooms for medical care. Furthermore, fewer personnel and apparatus may undermine a fire department's ability to meet National Fire Protection Agency's (NFPA) emergency response time guidelines and the Department of Labor's (DOL) two-in/two-out rule; operational guidelines put in place to establish response time standards and safety protocols for fire departments across the nation.

This thesis topic warrants graduate level research because it has the potential to effect an evolutionary change to the historical, and traditional, models under which fire departments operate. Fire departments must become more efficient with their resources to meet or improve service levels without increasing the operating budget. Once completed, this thesis may help a jurisdiction's elected leadership and fire department managers of organizations with similar attributes make informed decisions. The author's analysis will offer a set of recommendations on how to optimize employee availability and fire service delivery subject to operating budget constraints. Analyzing these recommendations may serve as a case study in which sufficient research may be conducted to thoroughly understand the issues at hand, offer potential policy change alternatives, and to provide a testing ground for which the policy changes can be thoroughly evaluated.

Aside from budgetary constraints, another complicating factor to be considered is the work schedules, staffing models, and the health and wellness of employees as it their

⁴ Rebecca Sizelove, "A Majority of Fire Departments Believe that if the Economic Crisis Continues, it Will Negatively Affect Their Ability to Serve Their Community," May 19, 2009, <http://www.ipsos-na.com/news-polls/pressrelease.aspx?id=4392>.

⁵ Jonathan Walters, "Firefighters Feel the Squeeze of Shrinking Budgets," *Governing Magazine*, January (2011).

availability to work. Work schedules may influence the emotional and physical condition of employees and result in higher leave usage and reduced employee availability. Less availability may lead to fewer fire apparatus being available for service. Staffing models often follow NFPA standards that require a minimum number of personnel to staff a fire apparatus. This standard may reduce the flexibility in staffing and result in fewer staffed apparatus to accommodate lower employee availability. The health and wellness of employees can also negatively impact the availability of employees because of health conditions.

B. WORK SCHEDULES

The fire service provides protection to the public 24 hours a day, seven days a week. Accordingly, departmental schedules have traditionally been based on a 24-hour schedule.⁶ The 24-hour schedule can be configured in many different ways, e.g., 10/14, 24/48, 12/12, 48/96. Each schedule type has advantages and disadvantages; for example, although the majority of fire departments in the United States abide by the 24/48-schedule, this schedule also leads to a significant sleep deprivation risk that impacts the employee's ability to function at peak levels.⁷ The 10/14-hour schedule produces better cognitive skills and less fatigue than longer schedules. However, it has also been found that it takes 25% more personnel to cover each 24-hour period; a substantial increase to the operating budget. The literature shows that a 10/14 shift equates to 42 hours worked

⁶ Albert Sierra, "From Twenty-Four to Something New, A Shift Away from the Traditional Work Schedule in the Fire Service" Executive Fire Officer Program (applied research project, National Fire Academy, 2001).

⁷ Steven Zwirn, Executive Fire Officer Program, "Examining the 72 Consecutive Hour Work Limit" (applied research project, National Fire Academy, 2007).

each week; alternatively, a 24/48 schedule averages 53 hours per week (not counting EDO (Kelly) days⁸).⁹

Furthermore, working longer shifts, such as a 24-hour shift can be beneficial to employees and their family.¹⁰ The typical 10/14 schedule requires the employee to work consecutive days; the schedule used by the DFD offers 48 hours off following a 24-hour work shift. A longer shift offers more time off between shifts, which can improve the employee's family life, and personal emotional stress. On the other hand, unlike other professions, such as airline pilots and over-the-road truck drivers, firefighters do not have mandatory rest periods and are subject to sleep deprivation during 24-hour or greater work shifts. Organizations must recognize that a conflict will arise between an employee's physical condition and work/family life. Whereas research has shown that an employee's family life is enhanced with longer breaks between work days, longer shifts also bear a physical toll resulting from fatigue and sleep deprivation.

1. Alternative Staffing Models

Consistent with NFPA Standard 1710, many fire departments staff each fire apparatus with four people.¹¹ According to the NFPA, four-person staffing is the optimal number of personnel who should be on board each fire apparatus for maximum efficiency

⁸ A Kelly day, or in DFD lexicon, an earned day off (EDO), is a nationally recognized fire service term. It is a day off given to firefighters to lower their hourly workweek below 53 hours above which overtime wages must be paid. Unlike fire and police employees, the Federal Labor Standards Act (FLSA) states that overtime wages must be paid when a workweek exceeds 40 hours. However, recognizing that police officers and firefighters must provide 24/7 protection to the public, often resulting in employees exceeding the 40-hour rule, the federal government has made an exemption (FLSA 7(k)), which allows organizations to pay their fire and police employees "straight" pay for up to 53 hours in a week or 212 hours across 28 continuous days. Therefore, a Kelly day, or EDO, is given to each employee to drop the average workweek below the 53-hour window. For example, in the DFD, every operational employee receives an EDO every seventh duty day, which thereby, lowers the average workweek to 48 hours. Without a Kelly day, or EDO, firefighters working a 24/48 or 48/96 would work an average of 56-hour workweeks and be entitled to three hours of overtime pay each week, an amount that would be cost prohibitive for most, if not all, governments.

⁹ Arthur Cote, ed., *Organizing for Fire and Rescue Services*, 1st ed. (Sudbury, MA: Jones & Bartlett Learning, 2003), 117–119.

¹⁰ Jonathon R. B. Halbesleben, "The Influence of Shift Work on Emotional Exhaustion in Firefighters," *International Journal of Workplace Health Management* 2, no. 2 (2009): 115–130.

¹¹ National Fire Protection Association, *Standard 1710*, 2010 ed. (Quincy, MA: National Fire Protection Agency, 2010).

and crew safety. Moreover, the United States Occupational Safety and Health Administration (OSHA) enacted the two-in/two-out rule, which states that before entering an “immediately dangerous to life and health” (IDLH) environment, at least two firefighters must be outside the environment before a crew of at least two personnel can enter the IDLH environment.¹² Therefore, with four personnel on board, two personnel can remain outside the IDLH environment while the other two can immediately engage in emergency operations inside the incident environment. Conversely, with less than four personnel on board, the first arriving apparatus would have to wait for another crew to arrive before actions in the IDLH environment could be initiated; however, staffing apparatus with three instead of four personnel would provide for more apparatus that might be close to the incident. Staffing all apparatus with four personnel leaves little flexibility in managing a department’s response capability. When a department is limited on its personnel budget, it often must resort to taking apparatus out of service, which can compromise effective response times for the balance of the department. According to the NFPA, crews are safer with four personnel but their safety can be equally compromised by protected response times of their supporting crews at fire incidents.

2. Nonproductive Time

Nonproductive time, e.g., sick leave, injury leave, and vacation, directly impacts employee availability. When personnel are sick or injured, the department’s ability to staff fire apparatus is comprised. Historically, it was customary for 10% of each day’s personnel complement to be on nonproductive time. Today, employee nonproductive time accounts for 20% of each day’s complement.¹³ Fewer available personnel equates to fewer staffed fire apparatus, which increases the number of runs for the remaining in-service apparatus; injury rates increase due to firefighter fatigue; nonproductive time continues to climb.

¹² United States Department of Labor, “OSHA Standard 1910.134(g) (4),” accessed July 9, 2013, http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=12716#1910.134%28g%29%284%29.

¹³ Cote, *Organizing for Fire and Rescue Services*, 117–119.

3. Community Impact

Budget cuts and loss of fire apparatus and crews have a significant impact upon the community that they serve. Fewer personnel result in fewer available fire apparatus that results in longer response times. Fires grow exponentially and protracted response times can result in significantly more damage. Moreover, life safety hangs in the balance for the public, and more crews will result in shorter response distances and times, and possibly being the difference between life and death. Fewer apparatus and longer response times can also negatively impact the public's confidence in their fire department's ability to save lives and property.

4. Summary

As noted, fire departments are struggling across the nation to balance their budgets. Cities, such as Dayton, Ohio, have experienced reductions in revenues that have resulted in corresponding budget cuts to the fire department. Work schedules, staffing inflexibility, and the health and wellness of personnel impacts employee availability and may result in reduced service levels. Work schedules impact the health and emotional condition of employees, as well as their fitness for duty leading to increased sick and injury leave occurrences. Closely associated with the work schedules, firefighter health and wellness can be impacted by the lack of rest and may lead to fatigue-related injuries. Finally, staffing inflexibility resulting from minimum staffing regulations limits the number of apparatus that can be put in service each day. Fewer apparatus will lead to higher average responses for the remaining crews. This decrease also may result in crews responding from farther distances, which will increase the amount of time before a lone fire apparatus at a fire emergency will receive assistance. All these factors inhibit fire management's ability to provide fire services to the public without an increase in its operating budget. In many cases, this increase is not an option.

C. RESEARCH QUESTIONS

The following questions are addressed in this thesis.

- Can fire service delivery be improved by optimizing employee availability through policies that support schedule modifications, alternative staffing models, or reductions in nonproductive time by implementing health and wellness initiatives?
- Given alternative policy options, can any one option or combination thereof optimize fire service delivery while still being cost neutral, legal, politically acceptable, efficient, and effective?

D. OVERVIEW OF UPCOMING CHAPTERS

The following chapters address policies that the DFD may consider as alternatives to cutting personnel and apparatus. The literature review focuses on policies related to optimizing personnel availability without increasing operating budgets. The status quo is for the DFD to reduce staffing and apparatus to meet operating budgets. Conversely, the ensuing chapters discuss how fire departments can raise fire service levels and increase personnel availability through policy alternatives, such as work schedule modification, alternative staffing models, and reducing nonproductive time usage. Utilizing the Morgan Jones' pros, cons, and fixes methodology, these policy alternatives are analyzed with an eye toward their costs, legality, political acceptability, effectiveness, and efficiency. Furthermore, a comparative analysis is conducted that compares results of the varying policy options against the status quo to provide information to other fire department managers of organizations with similar attributes to help them make informed decisions.

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II. LITERATURE REVIEW

Across the country, local fire departments are adjusting their operations in the face of smaller operating budgets. Literature suggests that alternative means do exist to increase fire service through alternative policies to optimize personnel availability. The literature review addresses three areas related to increasing the number of available fire apparatus each day without increasing operating budgets. The first section discusses research related to current work schedules and whether an alternative schedule would offer more personnel without increasing the operating budget. The second section reviews research related to the staffing for each apparatus and whether an alternative-staffing model could provide the flexibility necessary to staff additional fire apparatus. Finally, the third section addresses research related to possible strategies to reduce nonproductive time, i.e., sick and injury leave, and whether personnel availability is optimized, and thereby, enhance the ability to staff additional fire apparatus without increasing the operating budget.

A. WORK SCHEDULE MODIFICATION

The fire service is expected to provide service to the public 24 hours per day, seven days per week. Given this expectation, work schedules have traditionally been based on a 24-hour work period.¹⁴ Personnel within the DFD Emergency Services Division staff the fire apparatus that respond to requests for emergency service. These personnel work a 24/48 schedule, i.e., on duty for 24 continuous hours followed by 48 continuous hours off. During a three-week work cycle, they receive one EDO (earned day off) that reduces their average workweek to 48 hours.

Although the majority of U.S. fire departments abide by the 24/48 schedules, research shows that the 48/96 schedule is showing increasing popularity among U.S. fire departments with over 70 fire departments switching to it.¹⁵ It has been found that the

¹⁴ Sierra, "From Twenty-Four to Something New, A Shift Away from the Traditional Work Schedule in the Fire Service."

¹⁵ Zwirn, "Examining the 72 Consecutive Hour Work Limit."

48/96 schedule has been effective in reducing nonproductive time.¹⁶ All fire departments switching to the 48/96 schedule initially did so on a trial basis, but once the employees become accustomed to the change, and its advantages, few has wanted to revert back to their old schedule.¹⁷

Like the 24/48 schedule, the 48/96 schedules enjoy a 1:2 work to off-duty ratio, which affords employees ample rest time between work shifts that contributes to emotional stress between employees and their families.¹⁸ Not having a sufficient period of rest between work periods can lead to work-related fatigue and employee “burnout.” Attendance can be impacted when fatigue starts leading to “burnout” and that can lead to fewer personnel being available to staff fire apparatus. It has been found that 48 continuous hours of off-duty time may be beneficial in reducing the mental and physical “burnout” and fatigue attributed to work-related stressors.¹⁹

On the other hand, research has shown that the 48/96 schedule exacerbates sleep deprivation issues common to the 24/48 schedule. It has been stated sleep deprivation may lead to brain fatigue impairing reasoning skills, slowing reaction time, and decreased vigilance.²⁰ Lack of appropriate rest may also lead to human error and workplace accidents leading to higher injury leave usage. It has been found that a key factor in 90% of workplace accidents have occurred because insufficient sleep has led to human error.²¹

When operating under the limitation of a fixed operating budget, fire department managers must determine the most efficient means of employing their human capital. The literature shows that the fire service schedule has traditionally been based on a 24-hour

¹⁶ Allison Hawkes, “Evaluation of the 48–96 Shift for West Metro Fire Rescue,” *St. Anthony Hospitals*, October 2006.

¹⁷ Leeanna Mims, “Overtime Cost Reduction with Alternative Work Schedules” Executive Fire Officer Program (applied research project, National Fire Academy, 1999).

¹⁸ Rachel Arnow-Richman, “Redefining Work: Implications of the Four-Day Work Week: Rational Choice, Flexibility and Accommodation in the Workplace: Incenting Flexibility: The Relationship between Public Law and Voluntary Action in Enhancing Work/Life Balance,” *Conn.L.Rev.* 42 (2010): 1081–1527.

¹⁹ Nicole Jansen et al., “Need for Recovery from Work: Evaluating Short-Term Effects of Working Hours, Patterns and Schedules,” *Ergonomics* 46, no. 7 (2003): 664–680.

²⁰ Todd L. Poole, “The 48/96 Work Schedule: A Viable Alternative?” *Fire Engineering*, 165 (February 2012).

²¹ Zwirn, “Examining the 72 Consecutive Hour Work Limit.”

schedule that provides 24/7 coverage to the public. What still needs to be determined is whether an alternative schedule increases personnel availability for the DFD. The literature does not address the possibility of utilizing different schedules within an organization. Fire companies that routinely experience high call volumes will likely struggle with providing restorative rest for its personnel across a 48-hour work period. Additional research will need to be done to determine how personnel rest can be accommodated to minimize the risk of accidents and injuries related to fatigue.

B. ALTERNATIVE STAFFING MODELS

Consistent with NFPA Standard 1710, the DFD staffs each fire apparatus with four people.²² According to the NFPA, four-person staffing is the optimal number of personnel that should be on board each fire apparatus for maximum efficiency and crew safety. Moreover, OSHA enacted the two-in/two-out rule, which states that before entering an IDLH environment, at least two firefighters must be outside the environment before a crew of at least two personnel can enter the IDLH environment.²³ Therefore, with four personnel on board, two personnel can remain outside the IDLH environment while the other two can immediately engage in emergency operations inside the environment. Conversely, with less than four personnel on board, the first arriving apparatus will have to wait for another crew to arrive before actions in the IDLH environment could be initiated.

The literature shows that crew effectiveness is also positively impacted through four-person staffing. It has been proven that four personnel can perform tasks better and faster than crews of a smaller size.²⁴ For example, four person crews can operate as two person teams during fire hose evolutions that improve on the time needed to get water on a fire. During controlled tests conducted by the National Institute for Standards and Technology (NIST), it has been found that a four-person crew can get water on a fire

²² National Fire Protection Association, *Standard 1710*.

²³ United States Department of Labor, “OSHA Standard 1910.134(g) (4).”

²⁴ J. Averill et al., “Report on Residential Fire Ground Field Experiments,” forthcoming.

15% faster than a two-person crew and 6% faster than a three-person crew.²⁵ In a dynamic environment, such as a rapidly growing structure fire, getting an extinguishing agent on a fire faster is crucial to stopping it from spreading beyond the area of origin. Additionally, the NIST also found that search and rescue activities also benefit from four-person staffing. It found that a four-person crew could execute search and rescue activities 30% faster than a two-person crew and 5% faster than a three-person crew.²⁶ Four person search and rescue crews can operate as two, two-person teams, which maximizes crew efficiency.

The literature shows that 22 critical tasks are required at every residential structure fire.²⁷ Of the critical tasks, getting water on the fire and search and rescue activities are the most prominent. A four-person crew is only 6% faster with getting water on the fire than a three-person crew, and only 5% faster at search and rescue.²⁸ The performance difference between a four- and three-person crew is negligible and may be considered a manageable risk in exchange for staffing more fire apparatus.

Research still needs to be performed to determine whether three-person staffing can effectively get enough personnel on the scene to conduct emergency actions. How will three-person staffing impact the two-in/two-out rule? Whether more fire apparatus availability can help the department meet NFPA's 1710 response times and OSHA's two-in/two-out rule needs to be analyzed. Finally, more research needs to be done to determine the optimal model for locating apparatus with less than four personnel. The literature shows that five and six person crews would be beneficial in high-rise fires.²⁹ Should efforts be made to staff high-rise districts with more personnel since high-rise fires have more critical tasks to be performed? Research still must be completed to determine if a hybrid system can be effective whereas some apparatus are staffed with three people while other apparatus have four people.

²⁵ J. Averill et al., "Report on Residential Fire Ground Field Experiments."

²⁶ Ibid.

²⁷ James W. Hunt, "Making the Case," *Fire Chief* 54, no. 4 (2010): 32–42.

²⁸ Averill et al., "Report on Residential Fire Ground Field Experiments."

²⁹ Ibid.

C. NONPRODUCTIVE TIME REDUCTION

Nonproductive time, e.g., sick leave, injury leave, and vacation, can reduce the number of personnel available to staff apparatus each day. Therefore, it may be possible to implement strategies designed to reduce nonproductive time, and thus, increase personnel availability. More apparatus will improve availability and response times, reduce the average run volume across the department, and reduce reliance on outside communities to provide mutual aid assistance.

Historically, it was customary for 10% of each day's personnel complement to be on nonproductive time. Today, employee nonproductive time accounts for 20% of each day's complement.³⁰ Literature shows that strategies can be implemented to reduce nonproductive time and thereby increase the number of available personnel each day. Sick leave occurrences are over 22% lower when wellness checks are made on sick days attached to a Kelly day.³¹ The Cincinnati Fire Department in Ohio realized a 5% gain in "mean availability" of personnel by limiting their vacation approvals each day and by implementing a strict sick leave verification process.³²

Health and wellness initiatives have also been proven to have an effect on reducing nonproductive time. Exercise programs to improve the overall fitness of fire department employees can be effective in reducing injuries. The literature shows that overexertion caused half of the sprains and strains occurring each year in the fire service.³³ Reducing injury leave claims increases personnel availability that results in more staffed apparatus. The literature shows that a physician led health and wellness initiative can lead to a reduction in injury leave claims. The Howard County, Maryland

³⁰ Cote, *Organizing for Fire and Rescue Services*, 117–119.

³¹ Michael J. Fry, Michael J. Magazine, and Uday S. Rao, "Firefighter Staffing Including Temporary Absences and Wastage," *Operations Research* 54, no. 2 (2006): 353–365.

³² Ibid.

³³ Pat West, "Hidden Health Costs," *Fire Chief* 49, no. 5 (2005): 78–79.

Fire Department reduced its injury claims by 40% in the first year of implantation, and an additional 20% during the second year.³⁴

The literature shows a divergence in opinions on which work schedule is most beneficial for the employees and the agency. The 10/14 schedule is a commonly used schedule for fire departments throughout the country.³⁵ Research has shown that this schedule can be beneficial to the employee and the agency. The employees, working shorter shifts, benefit from more rest that would otherwise impair their cognitive skills. Moreover, studies have found that the stress incurred from longer shifts with the fire service can have physiological and psychological effects on the body.

Conversely, the literature shows that working longer shifts, such as a 24-hour shift, can be beneficial to employees and their family.³⁶ The typical 10/14 schedule requires the employee to work consecutive days; the schedule used by the DFD offers 48 hours off following a 24-hour work shift. A longer shift offers more time off between shifts that can improve the employee's family life and personal emotional stress.

Still to be determined through research is the return on investment (ROI) for health and wellness initiatives. In other words, how long will it take to recoup the money spent in implementing the program? The city will not fund a health and wellness initiative unless it is found to be beneficial. Therefore, providing the city with a plan addressing the ROI, and describing the benefits of the program, is integral to its approval.

To be determined through research is whether health and wellness initiatives can reduce injury leave that will result in lower workers' compensation premiums. Workers' compensation benefits come at a cost for municipalities. It is a State of Ohio insurance program funded by premiums paid by municipalities and private industry. The program increases premiums to agencies when it is determined that they have excessive injury

³⁴ Marc Leffer and Tifani Grizzell, "Implementation of a Physician-Organized Wellness Regime (POWR) Enforcing the 2007 NFPA Standard 1582: Injury Rate Reduction and Associated Cost Savings," *Journal of Occupational and Environmental Medicine* 52, no. 3 (2010): 336.

³⁵ A. Meirovitz, "Why Do Paramedics Work These Long 24-Hour Shifts," *Journal of Emergency Medical Services*, 16, no. 10 (October 1991): 45.

³⁶ Halbesleben, "The Influence of Shift Work on Emotional Exhaustion in Firefighters," 115–130.

leave claims. Reducing injury leave claims benefits the city through reduced premiums; the DFD would benefit with additional personnel availability.

D. SUMMARY

With a 40% reduction in fire apparatus since 1989, it is imperative that the DFD derive solutions to broaden its response capabilities utilizing available human capital and equipment. Alternative work schedules, staffing models, and nonproductive time reduction strategies must be researched to determine if any one or a combination of all three areas can be leveraged to increase staff availability each day.

This first area of research evaluates the current work schedule and determines if an alternate schedule is available to enhance the ability to staff more apparatus with the number of personnel on hand. The DFD currently uses a 24/48 schedule that provides the employees 48 hours off duty following a 24-hour duty shift. Alternatively, the 10/14 schedule splits each 24-hour period into a 10- and 14-hour shift with employees working consecutive days. This schedule is commonly used across the nation and can prove to be more efficient in reducing nonproductive time because shorter shifts are replaced versus an entire 24-hour shift. The shorter shifts are also better suited to provide rest to the employee to improve their cognitive skills at emergency scenes. However, the literature also shows that an employee's family life and emotional stress levels are lower when they have longer breaks between work shifts. It also found that the 10/14-hour shift requires 25% more personnel than the 24/48 schedule, which would increase the personnel budget.

Research must also be conducted to determine if alternative-staffing models can be effective in increasing total staffed apparatus throughout the city. The DFD staffs each fire apparatus with four personnel. The literature shows that four-person staffing is the most effective staffing model, and under some conditions, five and six personnel may be necessary. The literature also shows that the efficiency of four-person staffing versus three-person staffing is minimal. Further research needs to be conducted to determine if reducing some or all the apparatus to three-person staffing is beneficial, and where to locate the apparatus with three personnel. Response times are compromised and fail to

meet national standards under the current staffing model. Re-allocating personnel to increase the number of apparatus citywide will increase apparatus availability, and potentially, reduce the time it takes to arrive on an emergency scene.

Finally, reducing nonproductive time may increase the number of personnel available each day to staff fire apparatus. The literature shows that changing policies to reduce sick and vacation leave have effectively improved personnel availability. Health and wellness initiatives can also have a positive impact on injury leave. Research shows the exertion is a substantial contributor to work place injuries and a physician led health and wellness initiative may be effective in reducing injuries. A nexus also exists between the well-being of personnel and the schedule that they work. The literature shows that working longer hours, such as a 24-hour shift, can negatively impact an employee's health and should be considered when developing plans to reduce nonproductive time.

Strategies, such as alternative work schedules, staffing models, and nonproductive time reduction strategies, are supported by the literature as a means for increasing apparatus staffing. More research must be done to measure the effects of each of these strategies and whether they can positively impact the daily staffing levels for the DFD. Ultimately, firefighting is a personnel intensive profession; the more personnel who can be made available each day will dictate how many apparatus will be staffed to respond. This study helps define whether one, two, or all three strategies can be implemented to optimize the DFD response capability.

III. METHODOLOGY

A. METHOD STATEMENT

The object of this study is the DFD and its policies regulating work schedules, apparatus staffing, and employee nonproductive time. A policy analysis explores how current fire department policies can be modified to optimize employee availability to result in higher staffing levels and lower sick and injury leave usage. Work schedule modification, alternative staffing models, and reducing nonproductive time through health and wellness initiatives, are policy options worthy of analysis to improve employee availability. Each policy alternative can be viewed as a stand-alone solution or combined with the others. Regardless, the analysis must include, and be compared against, the status quo policies.

The DFD reduced the number of staffed fire apparatus that it staffs each day because of reductions to its operating budget, which has subsequently increased run volume, response time, and response distances for the remaining fire apparatus and crews. A review of the applicable research suggests that the DFD is a microcosm of an industry-wide problem in which fire departments across the country have seen their operating budgets cut because of fiscal crisis. Analyzing these policies may serve as a case study so that sufficient research may be conducted to understand the issues at hand thoroughly, to offer potential policy change alternatives, and to provide a testing ground in which the policy changes can be thoroughly evaluated.

Data sources for the policy analysis derive from literature review, internal policies, and reports review, and an analysis of how work schedules, staffing models, and nonproductive time impact other fire departments. A modified cost-benefit analysis approach is used to evaluate the data since the results may include both qualitative and quantitative values. For example, work schedule modifications to reduce work hours may improve cognitive skill but they also require more employees to provide the same amount of staffing, which drives up the operating budget. The Morgan Jones' pros, cons, and fixes technique is used to test the author's hypothesis that policy changes, such as work

schedule modification, alternative staffing strategies, and nonproductive time reductions through health and wellness initiatives, may optimize personnel availability and service levels. He lists the pros, cons, and fixes, and evaluates whether policy alternatives can be effective in increasing service levels without increasing the operating budget.

When completed, this thesis provides information to other fire department managers of organizations with similar attributes by helping them make informed decisions through data-driven research. His analysis offers a set of recommendations on how to optimize employee availability and fire service delivery subject to operating budget constraints.

B. COMPARATIVE ANALYSIS

A comparative analysis between the DFD and fire departments with similar attributes is conducted. Work schedules, staffing model, and nonproductive time policies are analyzed to determine whether their policies have effectively optimized personnel availability. The data is viewed to determine whether other fire department policies can effectively improve on DFD policy.

C. CRITERIA FOR JUDGING SUCCESS

Policies regulating work schedules, staffing models, and the health and wellness of employees impact personnel availability. Work schedules may affect the emotional and physical condition of employees that results in higher leave usage and reduced employee availability, which leads to fewer fire apparatus being available for service. Staffing models often follow NFPA standards that recommend a minimum number of personnel to staff a fire apparatus.³⁷ This standard reduces staffing flexibility that results in fewer staffed apparatus to accommodate lower employee availability. The health and wellness of employees can also negatively influence the availability of employees through sick and injury leave usage.

The success, or failure, of policies regulating work hours, staffing models, and personnel health and wellness, may be judged against the following criteria.

³⁷ National Fire Protection Association, *Standard 1710*.

- **Cost**—The policy analysis must result in a cost neutral, or cost saving, alternative policy, i.e., the revised policy cannot increase the department's operating budget, which includes start-up, as well as annual maintenance costs for policy implementation.
- **Legality**—The policy analysis must result in an alternative policy that will stand up against legal challenges, which also includes arbitration hearings that may occur should the local bargaining group deem that the policy is a breach of the current collective bargaining agreement.
- **Political Acceptability**—The policy analysis must result in an alternative policy that stands up to scrutiny by the local governing body and the public. The elected body governing the city is often the face of the government that has to buy-in to the policy changes to sell it to the public. To be politically acceptable, the policy alternatives must improve service levels to the public without incurring additional costs.

The local bargaining group also falls into these criteria. The local bargaining unit must be agreeable to the policy changes. They cannot violate contract provisions. Also, they must not bring undue risk or hardship upon them.

- **Effectiveness**—The policy analysis must result in an alternative policy that improves operational effectiveness. It must improve the department's ability to meet national response standards, increase the number of personnel available for duty each day, and reduce nonproductive time resulting from illnesses and injuries.
- **Efficiency**—The policy analysis must result in an alternative policy that ideally improves operational efficiency for the department, and at the least, be no less efficient. Efficiency is judged as providing higher levels of fire services without increasing the operating budget for the department or increasing taxes to the public.

Table 1 is a matrix that illustrates the five judging criteria the success of a policy option.

Policy	Cost	Legality	Political Acceptability	Effectiveness	Efficiency
Status Quo					
Schedule Modification					
Alternative Staffing Model					
Health and Wellness Initiative					
Combination					

Table 1. Criteria for Judging Success Matrix

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IV. STATUS QUO

A. DATA AND EVIDENCE

Currently, the DFD employs a 24/48 schedule policy during which employees work a 24-hour duty day immediately followed by 48-consecutive hours off duty. The duty day starts at 0700 hours and continues for 24 consecutive hours ending at 0700 hours the next day. The following two calendar days provide opportunities for employee rest, recuperation, and leisure. Additionally, EDOs are evenly distributed among the employees whereas they are given an extra day-off every seventh duty day, a contractually negotiated benefit that lowers the average workweek to 48 hours.

To accommodate the work schedule, the DFD assigns 315 personnel to emergency services. Divided evenly, 105 personnel are assigned to each platoon shift. Each day, the DFD staffs a minimum of eight engines, four ladder-trucks, seven medic units, two district chiefs, and one incident support unit; a minimum of 65 personnel are needed to staff these positions with an additional 40 personnel to compensate for nonproductive time, such as EDO, vacation, sick, and injury leave; on average, six persons are on nonproductive time each day within the DFD.³⁸ Staffing levels are established by the annual operating budget in which DFD personnel costs, like most fire departments across the United States, comprise over 80% of the budget.³⁹ Further limiting the number of staffed apparatus is the minimum staffing article in the current bargaining agreement stating that a minimum of four personnel must be staffed aboard each fire apparatus.

The DFD fire apparatus staffing policy follows NFPA Standard 1710 that recommends four-person staffing on all fire apparatus. Medic units have two person crews, the two district chiefs operate solo, and the incident support unit is a fire lieutenant

³⁸ Dayton Fire Department, *Emergency Services 2013 Overtime Hours and NonProductive Time Report* (Dayton, OH: Dayton Fire Department, 2013).

³⁹ IAFF Firefighters, "Economic Decline Threatens Staffing, Benefits," accessed May 17, 2014, <http://www.iaff.org/about/GP/jf03.html>.

who serves primarily as the EMS supervisor, also operating without a partner.⁴⁰ District chiefs, the ISU, or Incident Support Unit, a position within the Dayton Fire Department, and medic crews operate as support units are beyond the scope of NFPA 1710's staffing guidelines for fire apparatus, and therefore, do not follow its recommendations.

Staffing fire apparatus with four personnel allows DFD crews to arrive on the scene of fire emergencies immediately, which complies with the DOL's two-in/two-out policy enhancing personnel safety. The OSHA enacted the two-in/two-out rule to improve firefighter safety by compelling crews to have at least four firefighters on an emergency scene before entering IDLH environments. At least two firefighters must be available outside the IDLH environment before a crew of two or more firefighters may enter the environment. Therefore, with a four-person crew, two personnel can enter immediately on arrival while the other two standby outside.⁴¹ Four person crews have also been found to be more efficient and safer than smaller crews; whereas two, two-person teams can be formed to operate together as teams to reduce the risk of injury due to exertion. Furthermore, field experiments conducted by the NIST, and focused on crew safety and efficiency, found that four-person crews can perform tasks better and faster, get water on the fire 15% faster, and perform search and rescue operations 30% faster than smaller sized crews.⁴²

In addition to four-person minimum staffing for fire apparatus, NFPA 1710 also provides response time guidelines for EMS and fire response. This standard recommends that the entire first alarm response to a fire emergency must arrive on the scene within 480 seconds of dispatch 90% of the time.⁴³ Although not mandatory targets, the response standard establishes a response time goal for organizations, such as the DFD, to meet. Within the City of Dayton, the DFD uses this standard as performance goals and objectives to measure the level of service being providing to the public. In 2013, the DFD

⁴⁰ United States Department of Labor, "OSHA Standard 1910.134(g) (4)"; National Fire Protection Association, *Standard 1710*.

⁴¹ United States Department of Labor, "OSHA Standard 1910.134(g) (4)."

⁴² Averill et al., "Report on Residential Fire Ground Field Experiments."

⁴³ City of Dayton, *2012 Year-End Report*.

fell short of this measure by meeting the standard less than 63% of the time. Therefore, alternative policies should be examined that may provide more personnel, and subsequently, more fire apparatus, to reduce the response distances and times each day.

Prior to staffing cuts in 1989, DFD staffing levels consisted of 14 engines, six trucks, five advanced life support (ALS) transport units (medics), and five basic life support (BLS) units (ambulances). The staffing levels in 1989 afforded the DFD a redundancy in most stations whereas six double fire companies (engine and ladder truck complement) used to be available; today, the remaining 12 firehouses only accommodate one fire apparatus. The loss of double fire companies has eliminated the redundancy from having a second fire apparatus available to respond should another emergency dispatch be received at the firehouse. This shortfall resulted in protracted response times for alternative, and more distant, fire companies dispatched to incidents.⁴⁴

As stated earlier, today, the DFD has 105 personnel assigned to each platoon shift; the daily minimum staffing is only 65 personnel with the other 40 personnel being on nonproductive time, e.g., sick and injury leave, EDOs, and vacation. Over the past five years, the DFD has averaged five personnel being off each day on sick or injury leave.⁴⁵ Although wellness-fitness initiatives (WFI) have been shown to be effective in lowering nonproductive time usage,⁴⁶ and because of resource constraints, the DFD currently does not participate in such plans that may otherwise effectively reduce its nonproductive usage to provide personnel to staff additional apparatus.

However, the DFD does provide pulmonary function testing each year in compliance with the OSHA Code 29 CFR 1910.134 respiratory protection standard.⁴⁷ Each year a medical group is contracted to provide the services indicated to be in compliance with this law. During the course of their examinations, they have the latitude to provide additional testing that may be needed as indicated by the employee's medical

⁴⁴ Mark Gokavi, "Woman Mourns Loved Ones Lost in Dayton Duplex Fire," *Dayton Daily News*, sec. News, May 2, 2014.

⁴⁵ City of Dayton, *Department NonProductive Time Usage* (Dayton, OH: City of Dayton, 2013).

⁴⁶ Averill et al., "Report on Residential Fire Ground Field Experiments."

⁴⁷ Occupational Safety and Health Administration, "OSHA's Respiratory Protection Standard, 29 CFR 1910.134," *Fed Regist* 63, no. 5 (1998).

history. Although it has proven to be a contentious process between the medical group and the employees designated for advanced testing, it has proven to be effective in detecting medical problems that may have otherwise negatively impacted the employee. The medical results are confidential between the medical group and the employee with fire management and the City of Dayton only receiving notification that the employee is either “fit” or “not fit” for duty; those not fit are placed on sick leave while under rehabilitation. Currently, funding an expanded evaluation process for all employees to include a WFI is cost prohibitive under the current operating budget.

B. ANALYSIS

As described more fully in the Methodology chapter, the following analysis addresses the pros, cons, and fixes to analyze the status quo policies related to work schedule modification, alternative staffing strategies, and health and wellness programs, and their success in providing an effective and efficient fire service to the community. The criteria for success are evaluated on the following.

- Cost
 - The policy option must be cost neutral or more economical to justify its implementation
- Legality
 - The policy option must not violate any laws, ordinances, or governmental policies
- Political acceptability
 - The policy option must be agreeable to the local bargaining group particularly when it is addressed in an article of the current bargaining agreement. Additionally, the local elected body, i.e., Dayton City Commission, must be able to show its constituency how it is developing policies that enhance the services brought to them.
- Effectiveness
 - The policy option must be able to be equal to, or more effective, in meeting the objectives established by the current policy
- Efficiency

- The policy option must be able to demonstrate how the DFD is being good conservators of tax payer dollars by improving fire service delivery without additional budgetary dollars

The criteria take a modified cost-benefit approach in developing a matrix to judge sufficiently the potential for its success. It is recognized that more criteria are available but the author chose these criteria because of their ability to illustrate direct benefits to the city organization, fire organization, fire personnel, and the public.

1. Part I, Analysis of the Current Work Schedule

a. Pros

- Efficiency: Personnel work 24 continuous hours to provide seamless fire protection service that may otherwise be interrupted should shift changes occur throughout the day
- Efficiency: Shift change occurs each day at 0700 hours, which falls within the slowest run volume periods of the 24-hour shift to minimize service interruption
- Cost: Single shift changes at 0700 hours minimizes the overtime that would be paid if shift change occurred during busy mid-day periods, i.e., emergency incidents occurring proximal to shift change would result in overtime compensation until off-going personnel return to quarters
- Legality: A schedule commonly used by many fire department across the nation has also been contractually negotiated and agreed upon between Dayton Firefighters Local 136 (IAFF Local 136) and the City of Dayton
- Legality: Current 24/48 schedule provides an average 48-hour workweek as negotiated in the current labor agreement, which is well below the FLSA 7(k) exemption of a maximum 53-hour work week over which overtime compensation would have to be paid to firefighters
- Political Acceptability: The current schedule has been in place for well over 30 years, during which it has providing positive feedback to the City Commission from its constituency; therefore, the elected body would not likely move to alter the schedule
- Political Acceptability: The employees are satisfied with the schedule, particularly with the benefits of ample leisure time following duty days; otherwise, the political lobbying between IAFF Local 136 and the City

Commission otherwise result in a politically untenable position for fire management

- Effectiveness: The 24/48 schedule has effectively provided uninterrupted 24-hour fire service to the public, seven days a week, 365 days a year

b. Cons

- Effectiveness: Literature shows that 24-hour schedules can lead to sleep deprivation when crews respond to multiple emergencies throughout the night, which inhibits an employee's cognitive skills
- Cost: 24-hour shifts can lead to workplace injuries related to fatigue⁴⁸
- Cost: Fatigue related to 24-hour work shifts leads to human error and these types of errors cause over 90% of workplace accidents
- Political Acceptability: Excessive workplace accidents increases workers' compensation costs and may lead to pressure being placed upon the elected body to remedy the problem
- Costs: Requires 24 hours of overtime costs to maintain daily minimum staffing. Currently, the DFD has a minimum staffing policy requiring four personnel on board each fire apparatus at all times; therefore, requiring 24 hours of backfill overtime to cover a firefighter who is on some form of nonproductive time.
- Efficiency: Research shows that less than 3% of fire department activity occurs overnight.⁴⁹ When personnel are authorized to sleep during these periods, such as Dayton is, then an inefficient use of tax dollars is demonstrated by paying them while they sleep.

After reviewing, consolidating, and eliminating the cons, the following set of issues can be considered.

- Effectiveness: 24-hour schedules may lead to sleep deprivation when an employee's cognitive skills are inhibited.⁵⁰ Sleep deprivation may result

⁴⁸ Mims, "Overtime Cost Reduction with Alternative Work Schedules," 16.

⁴⁹ U.S. Fire Administration, Statistical Reports: Fire Departments, Topical Fire Report Series, "Fire Department Fire Run Profile," 7, no. 3 (December 2007), http://www.usfa.fema.gov/statistics/reports/fire_departments.shtm.

⁵⁰ Koen, "24/48 vs. 48/96 Work Schedules: A Comparative Analysis."

in workplace injuries with over 90% of workplace accidents being caused by fatigue⁵¹

- **Costs:** Will require 24 hours of overtime costs to cover nonproductive time when needed to meet daily minimum staffing; excessive costs may lead to political pressure being placed on the elected body and city administration to remedy the situation
- **Efficiency:** Unless they are responding to an emergency, personnel are being compensated while sleeping through the night

Once the issues have been identified, they are analyzed and the following measures are taken to neutralize as many negative issues as possible to convert them to positive issues. Table 2 is derived from an assessment of the pros and cons of the current DFD work schedule.

Cons	Fixes
Effectiveness: Literature shows that 24-hour schedules can lead to sleep deprivation when crews respond to multiple emergencies throughout the night, which inhibits an employee's cognitive skills	Institute "mandatory sleep" periods for personnel each day to manage the sleep deprivation. Crews experiencing high run volume through the day can be rotated out to a slower company to allow them a higher likelihood for rest during the balance of the platoon shift.
Costs: Will require 24 hours of overtime costs to cover nonproductive time when needed to meet daily minimum staffing	No Fix
Efficiency: Unless they are responding to an emergency, personnel are being compensated while sleeping through the night	No Fix—rest will help alleviate sleep deprivation complications

Table 2. Cons and Fixes for Current Work Schedule

This analysis shows that one of the cons can be mitigated but not totally fixed and two cannot be fixed at all. According to Jones, when employing a 24/48-work schedule, the fire departments would have to be willing to bear the burden of these cons. Therefore, even though longer shifts have the potential to exacerbate stress, fatigue, and injuries,

⁵¹ Poole, "The 48/96 Work Schedule: A Viable Alternative?," 85.

sleep deprivation resulting from this schedule can be managed and the damage from its effects can be mitigated.

2. Part II, Analysis of the Current Staffing Model

a. Pros

- Efficiency: Two-in/two-out compliant on arrival allowing for immediate action in an IDLH environment
- Effectiveness: The study found that four person fire crews were capable of completing 22 essential firefighting and rescue tasks in a typical residential structure 25% faster than a three person crew
- Effectiveness: NFPA 1710 Standard is 15 firefighters on the scene at structure fires. The DFD fire response meets this standard by dispatching three engines, one ladder-truck, a district chief, and an ISU to all fire responses.
- Cost: Four-person staffing does not increase the operating budget; it merely dictates the number of apparatus that can be staffed on a given day with the number of available personnel
- Legality: Four-person staffing is a negotiated article within the current labor agreement
- Political acceptability: Four-person staffing is the accepted staffing standard prescribed by NFPA Standard 1710
- Cost: Four-person staffing may be effective in reducing work-related injuries related to fatigue because more firefighters are available to share the work load
- Effectiveness: High-rise fires require more personnel to initiate emergency interventions than standard dwelling fires. A high-rise response includes four engines, two ladder trucks, two district chiefs, and an ISU. Having four person crews on the apparatus allows the crews to split into two-two person teams that can work concurrently, and therefore, perform critical tasks more efficiently.

b. Cons

- Efficiency: Mandating a defined minimum of four persons per apparatus can inhibit flexible staffing policies that can accommodate employee absences requiring overtime staffing at premium pay to maintain the four-

person staffing. Without the defined minimum, the fire department could shift personnel resources, i.e., the fourth person, to cover absences.

- Effectiveness: Four-person minimum staffing reduces the possible number of apparatus that can be placed in service without hiring overtime personnel who would increase the overtime expenses. Adding additional apparatus without increasing the operating budget enhances the capability by increasing apparatus availability, decreasing response distances, and reducing post-dispatch response times.
- Efficiency: Literature shows that the time needed for four-person crews to complete tasks is only slightly better than smaller crews
- Legality: Four-person staffing is a negotiated article contained within the current bargaining agreement and the local bargaining group will not agree to lower the minimum staffing of fire apparatus below four persons
- Political Acceptability: Elected body must consider complaints from neighborhoods and citizens for reduced fire protection when fire apparatus is taken out of service for lack of available personnel

After reviewing, consolidating, and eliminating the cons, the following set of issues can be considered.

- Efficiency: Mandating a minimum of four persons per apparatus prevents flexible staffing for re-distribution of personnel who can accommodate employee absences requiring overtime staffing at premium pay to maintain the four-person staffing
- Efficiency: Literature shows that the productivity differences between three-person and four-person crews are minimal
- Political Acceptability: Elected body must consider neighborhood and citizen groups complaints about reduced fire protection when fewer apparatus are available
- Legality: The local bargaining group will likely not be amenable to renegotiating the minimum staffing article in the contract; i.e., lowering the minimum staffing to less than four persons

Once the issues have been identified, they are analyzed and the following measures are taken to neutralize as many negative issues as possible to convert them onto positive issues. Table 3 is derived from an assessment of the pros and cons of NFPA Standard 1710.

Cons	Fixes
Efficiency: Mandating a minimum of four persons per apparatus prevents flexible staffing that can accommodate employee absences requiring overtime staffing at premium pay to maintain the four-person staffing	No Fix—backfilling for absences requires overtime personnel to staff those apparatus with four persons
Literature shows that the productivity differences between a three-person and four-person crew are minimal	No Fix—must maintain four-person staffing
Political Acceptability: Elected body must consider neighborhood and citizen groups complaints about reduced fire protection when fewer apparatus are available	No Fix
Legality: The local bargaining group will likely not be amenable to renegotiating the minimum staffing article in the contract; i.e., lowering the minimum staffing to less than four persons	No fix unless Local 136 is willing to negotiate a change to the minimum staffing article

Table 3. Cons and Fixes for Current Staffing Model

This analysis shows that three of the four cons cannot be mitigated with only the fourth being possible in the unlikely event that they would be willing to renegotiate the staffing article. According to Jones, maintaining four-person minimum staffing for all fire apparatus, the fire departments would have to be willing to bear the burdens of these cons. Maintaining four-person staffing is a nationally recognized standard to provide for crew safety and fire scene efficiency.

3. Part III, Reducing Nonproductive Time

a. Pros

- Efficiency: Current pulmonary function testing increases the number of available personnel each day by identifying employees who may be at risk to adverse medical conditions based on their health history. The examining physician has the latitude to provide additional testing that may be needed as indicated by the employee's medical history. Identifying and

treating these conditions early may prevent illnesses resulting in employee absences.

- Effectiveness: Reduce the average call volume through additional response capability potential; absence reduction increases employee availability and the department's ability to increase the number of available apparatus to share in the daily run volume.

Although it has proven to be a contentious process between the medical group and the employees designated for advanced testing, it has proven to be effective in detecting medical problems that may have otherwise negatively impacted the employee, which does enhance the employee's quality of life.

- Political acceptability: Reduced reliance on mutual aid from neighboring communities because fewer absences enhance the ability to staff additional apparatus
- The medical results are confidential between the medical group and the employee with fire management and the City of Dayton only receiving notification that the employee is either "fit" or "not fit" for duty; those not fit are placed on sick leave while under rehabilitation.
- Cost: Reduction in workers' compensation claims because the pulmonary function testing is detecting work-related medical problems in its early stages that may mitigate employee absences
- Efficiency: Improved quality of life for employees who may otherwise be affected by a life altering health condition if it had not been detected early
- Legality: Compliant with 29 CFR 1910.134(c)(4) mandating medical evaluations, and whereas, medical evaluations will be provided at no charge to the employee⁵²

b. Cons

- Political Acceptability: Employees distrust management and consider respiratory function testing as a means to terminate employees for failure to meet fitness standards
- Cost: Respiratory function testing is paid for out of fire department operating budgets, which reduce funds that may otherwise be available for additional staffing

⁵² United States Department of Labor, "OSHA Standard 1910.134(g) (4)."

- Effectiveness: Employees may be found “unfit” for duty pending rehabilitation, which increases the department’s nonproductive time
- Efficiency: Responses may be delayed or crews out of service resulting from the physicals taking place

After reviewing, consolidating, and eliminating the cons, the following set of issues can be considered.

- Political Acceptability: Employees distrust management and consider respiratory function testing as a means to terminate employees for failure to meet fitness standards and may be exacerbated by employees being deemed “unfit for duty” pending rehabilitation under physicians supervision
- Cost: Respiratory function testing is paid for out of fire department operating budget which reduces funds that may otherwise be available for additional staffing
- Efficiency: Emergency response may be delayed because crews are out of service for physicals

Table 4 is derived from an assessment of the pros and cons of the current DFD wellness initiative.

Cons	Fixes
Political Acceptability: Employees distrust management and consider respiratory function testing as a means to terminate employees for failure to meet fitness standards and may be exacerbated by employees being deemed “unfit for duty” pending rehabilitation under physicians’ supervision;	Maintain confidentiality with Fire Management only being advised of whether an employee is “fit” or “unfit” for duty. This status and the rehabilitation under a physician’s supervision will seek to return the employee to duty once deemed fit and no longer in danger of a life threatening health event.
Cost: Respiratory function testing is paid for out of fire department operating budget reducing funds that may otherwise be available for additional staffing;	No fix—city administration and its Office of Management and Budget has decided that this cost must be paid for out of the fire department’s operating budget.
Efficiency: Emergency response may be delayed because crews are out of service for physicals	No fix—would require overtime expenditures to backfill them during their absence

Table 4. Cons and Fixes for Current Wellness Initiative

This analysis shows that one of the cons can be mitigated. The DFD will only receive notice that the employee is either “fit” or “unfit” for duty. Maintaining the doctor/patient confidentiality will improve trust and faith between the employee and employer while under rehabilitation. The unmitigated cons will be the burden that the governing agency must bear respective to respiratory function test compliance. The author believes that this con is an acceptable burden because it has the potential to detect a life altering physical condition that, with proper care, can be mitigated and allow the employee to return to duty. Conversely, not detecting certain conditions in a timely manner may lead to tragic results, up to and including, death.

C. SUMMARY

The DFD currently employs a 24/48 schedule and has done so for multiple decades. It has worked well in providing continual fire protection to the public with minimal disruptions resulting from shift change that occurs at an early morning, low demand time period.⁵³ This schedule is commonly used by many fire departments across the nation, has been contractually negotiated with the local bargaining group, and complies with Fair Labor Standards Act Rule 7(k) regarding firefighter work hours.

On the other hand, the 24-hour workday can lead to sleep deprivation that may impact employee cognitive skills, backfill overtime to replace absent employees for 24-hours at a pay rate of 1.5 times the normal base, and employees are being compensated while sleeping. The risk of sleep deprivation and its impact on cognitive skills can be managed through mandatory rest periods through the day, but the backfill overtime and compensation during sleep time are a burden that the DFD must bear while maintaining the current work schedule.

The DFD employs a four-person staffing model on its fire apparatus. This policy offers immediate compliance with OSHA’s two-in/two-out rule, performs the 22 essential firefighting tasks at low-risk residential structure fires 25% faster than a three-person

⁵³ U.S. Fire Administration, Statistical Reports: Fire Departments, Topical Fire Report Series, “Fire Department Fire Run Profile.”

crew, and meets NFPA 1710's recommendation to have 15 firefighters available at a fire scene with one alarm sounded.

Conversely, this model does not provide for flexible staffing models that can accommodate employee absences requiring overtime staffing at premium pay to maintain the four-person staffing. Also, the elected body will have to consider the political impact when budget restrictions reduce the number of fire apparatus available that could be countered with flexible staffing to allow for more apparatus each day. Each of these cons cannot be readily fixed, and therefore, are considered burdens that the DFD must bear while maintaining a four-person staffing model.

Consistent with 29 CFR 1910.134(c)(4), the DFD provides pulmonary function testing to its employees to assess their ability to function as a firefighter wearing a breathing respirator; a limited application into the wellness/fitness realm, and while complying with OSHA's annual respiratory function testing requirement, identifies and provides medical testing to at-risk employees. Early detection during pulmonary function testing mitigates absences, and thus, increases the number of available personnel each day. More personnel equates to more staffed apparatus available to absorb the workload to reduce fatigue-related injuries, mutual aid reliance, and an overall improvement in employee quality of life.

Implementing the pulmonary function test is an expense that they DFD must provide in its annual operating budget. It is mandated by federal regulations, and therefore, it is an unavoidable burden that the department must bear. Also, employees have a distrust of fire management and believe that the testing is a tool to remove them from the job if they are found to be "unfit," and taking crews out of service to receive the testing reduces the level of fire service provided each day. Whereas, employee trust can be improved by maintaining doctor/patient confidentiality, which is also considered a burden that the DFD must bear to be compliant with federal regulations, and reducing nonproductive time.

Each of these policy options has been judged on their effectiveness, efficiency, cost, legality, and political acceptability. The status quo policy has been evaluated and summarized as illustrated in Table 5.

Policy	Cost	Legality	Political Acceptability	Effectiveness	Efficiency	Recommend Implementation
Status Quo	High	Yes	Yes	No	No	No

Table 5. Evaluation Criteria for the Status Quo Policy Options

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V. SCHEDULE MODIFICATION

A. DATA AND EVIDENCE

Similar to the 24/48 schedule used by the DFD, the 48/96 schedule is worthy of further analysis for its ability to optimize firefighter availability. The 48/96 schedule, like the 24/48 schedule, is similar in structure with both having a 1:2 duty to off-duty ratio.⁵⁴ This schedule is finding increasing popularity with more than 70 fire departments having switched to this schedule.⁵⁵

Schedule modification is a significant change to a fire department's organization. In a change-averse culture, such as the fire service, methods must be taken to reduce any conflict and anxiety arising from a schedule change. To ease the acceptance, all fire departments transitioning to this schedule have historically done so on a trial basis in which fire management or labor may opt out during the trial period. However, once accustomed to the change, and its advantages, few departments have reverted to their former schedule.⁵⁶ Firefighters have found the newfound flexibility offered by more continuous days off has benefitted their lifestyles and leisure, while the organization has benefitted by reductions in sick and injury leave usage.

Reducing employee absences, and thereby, increasing firefighter availability, may be realized if the work schedule is modified to reflect a 48/96-schedule. Improved availability provides more personnel to staff fire apparatus on a daily basis; more staffed apparatus available to respond to emergencies may reduce response times and distances, and thus, improve service to the City of Dayton without increasing the operating budget. The following fire departments have realized a reduction in sick leave usage since implementing the 48/96-schedule.

- West Metro Fire Protection District—28% reduction in sick leave usage
- Minneapolis—34% reduction in sick leave usage

⁵⁴ Koen, "24/48 vs. 48/96 Work Schedules: A Comparative Analysis."

⁵⁵ Zwirn, "Examining the 72 Consecutive Hour Work Limit."

⁵⁶ Mims, "Overtime Cost Reduction with Alternative Work Schedules."

- Pacifica—0% reduction in sick leave usage
- Half Moon Bay—10% reduction in sick leave usage
- Manhattan Beach—80% reduction in sick leave usage

These statistics show that the 48/96 work schedule may reduce nonproductive time, and thereby, improve the operational capabilities of the organization, as well as the health of the employees. Employee health is enhanced because the four days off between work periods offers them opportunities to recuperate from work-induced fatigue.⁵⁷ Shorter periods of rest impact the employee's ability to recuperate.⁵⁸ Research has found that recovery from a shift does not occur by the end of the first off-duty day and may occur only by the end of the second off-duty day.⁵⁹ Too short of a period of recuperation time could be an explanation for the high levels of need for recovery for irregular shift workers, such as firefighters.

Hazards and life threatening danger is ever evolving and firefighters must be constantly alert and focused on scene safety. Crews must be rested, alert, and cognizant of their surroundings in the dynamic fire-scene environment. Inadequate rest is a factor in human error that results in 90% of workplace accidents involving firefighting and other fire service activities being executed during public protection.⁶⁰ Accidents may lead to injuries in the field that further exacerbates nonproductive time usage and impairs the department's ability to optimize its operations. A minimum 3:4 work/rest ratio ensures sufficient rest and prevents cumulative fatigue and sleep debt.⁶¹ The 48/96 work schedule, while providing a 1:2 work/rest ratio, exceeds the 3:4 work/rest ratio, and thereby, supports adequate rest cycles for employees. Therefore, the 48/96 schedule supports the reduction of duty-related injuries, and also enhances firefighter availability.

⁵⁷ Hawkes, "Evaluation of the 48–96 Shift for West Metro Fire Rescue."

⁵⁸ Jansen et al., "Need for Recovery from Work: Evaluating Short-Term Effects of Working Hours, Patterns and Schedules," 664–680.

⁵⁹ Ibid.

⁶⁰ Poole, "The 48/96 Work Schedule: A Viable Alternative?" 85–89.

⁶¹ Koen, "24/48 vs. 48/96 Work Schedules: A Comparative Analysis."

The 48/96 schedule enhances the emotional, physical, and mental welfare of the employees; more engagement with their family life, work life, and tendency to be better rested are all positive attributes for a more effective workforce.⁶² Firefighters have been found to have a higher incidence of divorce and alcohol abuse, and are more likely to suffer from emotional problems than those working conventional eight-hour schedules.⁶³ Having too short of a rest period between duty days contributes to the emotional stress between employees and their families.⁶⁴ The 48/96 schedule reduces the amount of time firefighters are away from their family, which heightens their ability to be engaged fully and a more participative member of the family.⁶⁵ Being home for 48 consecutive hours allows firefighters to sleep later in the morning and to get their children on the school bus across three consecutive days whereas shorter off-duty intervals fail to provide the same benefit. The 48/96 schedule also provides 26 full weekends off per year whereas a 24/48 schedule, another attractive schedule option, only offers 17 full weekends off.⁶⁶ As a result, employees have more home or leisure time who may otherwise use sick and vacation leave to increase their off-duty time between shifts. Four consecutive days off offers ample time to recuperate, rest, and fully engage with family.

Family life may also be affected by longer continuous work. Longer shift duration may be stressful for spouses because of the fatigue related to being a sole parent for 48 straight hours.⁶⁷ These challenges can be problematic as emotional stressors placed upon employees trying to cope with their family life while off duty. This situation, coupled with the fatigue often accompanying a 48-straight hour work shift can lead to health concerns and increased use of sick leave.⁶⁸

⁶² Ibid.

⁶³ Sierra, "From Twenty-Four to Something New, A Shift Away from the Traditional Work Schedule in the Fire Service."

⁶⁴ Arnow-Richman, "Redefining Work: Implications of the Four-Day Work Week: Rational Choice, Flexibility and Accommodation in the Workplace: Incenting Flexibility: The Relationship between Public Law and Voluntary Action in Enhancing Work/Life Balance," 1081–1527.

⁶⁵ Koen, "24/48 vs. 48/96 Work Schedules: A Comparative Analysis."

⁶⁶ Poole, "The 48/96 Work Schedule: A Viable Alternative?" 85–89.

⁶⁷ Hawkes, "Evaluation of the 48–96 Shift for West Metro Fire Rescue."

⁶⁸ Ibid.

The mental benefit of the employee is also improved through the 48/96-schedule. It has been found that employees experience less mental fatigue and stress with this schedule because of the longer transition time between duty days.⁶⁹ This schedule allows employees a better opportunity to “switch gears” from their work mentality to their leisure mentality. Mental fatigue and stress may be prohibitive in effective worker production and has been found to run the risk of poor employee behavior, and may lead to public complaints.⁷⁰

Conversely, research has shown that working 24 or more continuous hours can also be found to be counterproductive with sleep deprivation leading to higher levels of employee fatigue. Studies have shown that sleep deprivation can lead to behaviors similar to increased levels of blood-alcohol content (BAC);⁷¹ 18 hours without sleep has been found to be equivalent to a 0.05 blood-alcohol content, and 24 hours without sleep equates to a 0.10 blood-alcohol content. Sleep deprivation also leads to brain fatigue that slows a person’s reaction time, decreases vigilance, and impairs reasoning skills.⁷² These behaviors can have a devastating effect on employees working in high-hazard environments, such as fire scenes. Personnel must be keenly aware of their environment for their safety and that of their crew; the effects of sleep deprivation can result in injuries. Injuries not only impact the employee, they also affect the organization by increasing nonproductive time related to injury leave and reduces the employee’s availability.

Research has found that firefighter injuries occur most often while fighting fires.⁷³ Muscular sprains and strains are the predominant injuries arising from firefighting operations, over half these injuries are related to fatigue and exertion.⁷⁴ The sleep

⁶⁹ Hawkes, “Evaluation of the 48–96 Shift for West Metro Fire Rescue.”

⁷⁰ Zwirn, “Examining the 72 Consecutive Hour Work Limit.”

⁷¹ Poole, “The 48/96 Work Schedule: A Viable Alternative?” 85–89.

⁷² Koen, “24/48 vs. 48/96 Work Schedules: A Comparative Analysis.”

⁷³ Zwirn, “Examining the 72 Consecutive Hour Work Limit.”

⁷⁴ National Institute of Standards and Technology, *The Economic Consequences of Firefighter Injuries and Their Prevention. Final Report*, (NIST GCR 05–874) (Arlington, VA: TriData Corporation, a Division of System Planning Corporation, March 2005).

deprivation created while working 48 consecutive hours may exacerbate said fatigue and exertion.⁷⁵ Therefore, the consequence of workplace injuries and illness may increase while operating under a 48/96 schedule, which hampers a fire department's ability to optimize its operations as a result of lower employee availability.

Many factors can cause sleep deprivation, in addition to long work hours. Fatigue can be the result of family life, illness, and raising newborn children. All these factors have the potential to impair an employee's ability to work in the firehouse. It is incumbent upon a supervisor to recognize a fatigued employee and the risks that may result. The fire service is based on crew level evolutions in which firefighter safety is dependent upon other crewmembers. Therefore, this condition must be managed and policies should be prepared that addresses an employee's inability to perform regardless of the cause.

B. ANALYSIS OF SCHEDULE MODIFICATION POLICY CHANGE

An analysis of the data and evidence suggests that "pros" and "cons" exist for fire departments changing to the 48/96 work-schedule. The "pros" for this schedule lie in its cost, legality, political acceptability, effectiveness, and efficiency.

Fire departments should not realize any additional costs associated with the 48/96 schedule. The 48/96 schedule is cost neutral in comparison to the 24/48-hour schedule; both schedules have 1:2 work/off-duty ratios and the same amount of duty-hours in a workweek. Kelly days are still used to reduce the average number of hours in a workweek to maintain FLSA compliance. The 48/96 schedule has also been found to be effective in reducing sick and injury leave that may lead to backfill overtime personnel to fill the void left by the absence.

The 48/96 schedule is legal and complies with FLSA laws by complying with the 7(k) exemption that allows firefighters to work up to 53 hours in a week without being compensated at 1.5 times their normal hourly rate for time worked beyond 40 hours.⁷⁶

⁷⁵ Mims, "Overtime Cost Reduction with Alternative Work Schedules."

⁷⁶ Ibid.

Fire departments can still employ Kelly days that will lower the average workweek below the 53-hour threshold.

The political acceptability lies in the local bargaining unit's acceptance because of the benefits its membership will receive. It doubles the continuous off-duty time, increases the number of entire weekends that an employee will be off in a given year, and provides more rest between duty shifts, which thus, reduces the potential for employee burnout.

The city's elected body will also find it politically beneficial. It will find fire service delivery is enhanced because shift changes are occurring half as much as with the 24/48 schedule. The elected body can show how it is providing enhanced fire services to its constituents through more efficient operations.

The fire department will become more effective because of the schedule changes that occur half as much as with the 24/48 schedule. Reducing the number of shift changes increases potential fire apparatus availability and limits delayed emergency response. Personnel staffing is typically planned on the prior duty day with assignments being made for which apparatus the firefighters may be assigned to on the following duty day. Therefore, when an employee calls in sick prior to a shift, it triggers actions necessary to fill the unplanned void created by the absence. The same may still occur with the 48/96 schedule but only half as many times as with the 24/48 schedule. It has also been found that once employees are at work, they tend to not go home sick; therefore, sick leave usage may be reduced for the entire 48-hour work shift.⁷⁷ Routine delays in response caused by shift change will only occur half as much as what may occur with a 24/48 schedule.

Cost efficiency is also enhanced because firefighters are less likely to call in sick on their second day of duty since they are already on duty, and as such, absences are potentially reduced by one half.⁷⁸ Therefore, having the employee present for the start of

⁷⁷ Poole, "The 48/96 Work Schedule: A Viable Alternative?" 85–89.

⁷⁸ Hawkes, "Evaluation of the 48–96 Shift for West Metro Fire Rescue."

the second 24-hour period reduces the need for overtime, which is largely caused by sick leave usage.⁷⁹

The data and evidence suggests that the 48/96 schedule also has “cons” that should be considered. These negative aspects may be found in additional costs, political acceptability considerations, reduced effectiveness, and less efficient personnel.

Personnel costs may increase because of employees taking sick, injury, or vacation leave. Unlike a 24/48 schedule that results in a 24-hour absence, a staffing void occurs for up to 48 hours that may have to be filled by overtime personnel who are compensated at the premium pay rate of 1.5 times their normal hourly compensation.

The elected body may find this schedule to politically unacceptable. Research suggests that the 48/96 schedule may lead to sleep deprivation that has been found to result in poor employee behavior and service delivery, and therefore, may lead to an increase in public complaints arising out of these behaviors.

Crew effectiveness may also be affected by the 48/96 schedule. Working 48 continuous hours with little or no rest can result in severe sleep deprivation.⁸⁰ Sleep deprivation impacts employee cognitive skills, reasoning skills, and injuries resulting from fatigue. Each of these directly impacts the fire employees and their department’s ability to execute its mission.

Sleep deprivation may affect personnel efficiency under the 48/96 work schedule. It may lead to more fatigue-related injuries, and therefore, reduce personnel availability, and also potentially, increase the need for back-fill overtime to cover the absence, which thereby, increases operating costs.

After reviewing, consolidating, and eliminating the cons, the following set of issues can be considered.

- Cost, political acceptability, and effectiveness: Sleep deprivation may lead to fatigue-related injuries, reductions in cognitive and reasoning skills, poor employee behavior, and poor service delivery. These issues increase

⁷⁹ Mims, “Overtime Cost Reduction with Alternative Work Schedules.”

⁸⁰ Koen, “24/48 vs. 48/96 Work Schedules: A Comparative Analysis.”

personnel costs when having to fill absences with overtime personnel, elevated danger when employees cannot readily evaluate hazards before them, and citizen complaints to the elected body resulting from employee/citizen engagement.

Once the issues have been identified, they are analyzed and the following measures are taken to neutralize as many negative issues as possible to convert them to positive issues. Table 6 is derived from an assessment of the pros and cons for the schedule modification policy option.

Cons	Fixes
Sleep deprivation may lead to fatigue-related injuries, reductions in cognitive and reasoning skills, poor employee behavior, and poor service delivery. These issues increase personnel costs when having to fill absences with overtime personnel, elevated danger when employees cannot readily evaluate hazards before them, and citizen complaints to the elected body resulting from employee/citizen engagement.	Sleep deprivation can be managed by providing mandatory rest periods for personnel as they are commencing their second 24-hour work period. Two-hour naps have been found to be restorative for those working in excess of 18 continuous hours. ⁸¹
The slowest run volume period occurs between 11:00 pm and 7:00 am. ⁸² Firefighters are authorized to sleep during this period when not responding to emergencies. The public may view this sleep period as an inefficient use of taxpayer dollars	Authorizing firefighters to sleep through the night addresses sleep deprivation issues that will enhance employee performance and mitigate potential health effects related to fatigue. The elected body should engage the public and educate them on the benefits of having rested firefighters protecting their city.

Table 6. Cons and Fixes for Schedule Modification

⁸¹ Poole, “The 48/96 Work Schedule: A Viable Alternative?” 85–89.

⁸² U.S. Fire Administration, Statistical Reports: Fire Departments, Topical Fire Report Series, “Fire Department Fire Run Profile.”

C. SUMMARY

Similar to the 24/48 schedule currently employed by the DFD, a 48/96 schedule is similar in structure with both possessing a 1:2 duty to off-duty ratio. Changing to a 48/96 schedule will not increase operational costs because it does not change the number of personnel or hours of work across a pay period. It has been found to decrease the sick and injury leave usage that lowers overtime operating costs below current levels. Reducing leave usage increases employee availability to allow for more staffed apparatus without a corresponding cost increase that thereby optimizes fire department operations. This schedule is also an efficient scheduling model because sick leave is seldom used once an employee is at work; therefore, the overtime costs are reduced to backfill an unplanned absence that would have otherwise occurred under the current schedule.

Changing to the 48/96 schedule also benefits the employees. Increasing their off-duty time from the current 48 hours to 96 hours increases their ability to engage with their families and to catch up with their rest before returning to duty. More time off enhances their ability to recover from work by improving their emotional, mental, and physical stressors related to working 48 straight hours.

On the other hand, sleep deprivation decreases cognitive and reasoning skills that increases the risk for fatigue-related injuries, and may lead to poor employee behavior and service delivery. The 48/96 schedule has the potential to raise personnel costs as backfill overtime personnel being compensated at 1.5 times their normal rate of pay must often replace an absent employee for the entire 48 hours. Furthermore, the public may view this backfill overtime personnel as an inefficient use of taxpayer dollars, and thus, potentially view allowing personnel to sleep during the night to be inefficient.

The positive attributes of the 48/96 schedule outweigh the potential negative attributes and changing the schedule policy may be a worthwhile endeavor to optimize fire department operations. Whereas the risk of sleep deprivation is a negative attribute that has the potential to affect all employees and the organization, it can be managed by allowing for mandatory rest periods throughout the duty day. Educating the public about the positive attributes of rested employees, and how these attributes can enhance service

delivery by keeping personnel on a finely tuned edge, can serve as a mitigating factor in improving its political acceptability.

The schedule modification policy option has been evaluated and summarized as illustrated in Table 7.

Policy	Cost	Legality	Political Acceptability	Effectiveness	Efficiency	Recommend Implementation
Schedule Modification	Neutral	Yes	Yes	Yes	Yes	Yes

Table 7. Evaluation Criteria for the Schedule Modification Policy Option

VI. ALTERNATIVE STAFFING

A. DATA AND EVIDENCE

Alternative staffing models may be another strategy worthy of analysis to evaluate whether it can optimize fire department operations without increasing operating budgets or the risk of injury during emergency operations. Like schedule modification strategies, the number of available personnel for each platoon shift will not change. Instead, lowering the minimum staffing levels for fire apparatus to three personnel offers the DFD an opportunity to improve fire service delivery without increasing its operating budget.

The NFPA recognizes that the two most important elements in limiting fire spread beyond its point origin are (a) quick arrival of resources, and (b) personnel of sufficient numbers to limit fire spread to its point of origin.⁸³ NFPA Standard 1710 recognizes four-person staffing on fire apparatus as the optimal crew size for safety and efficiency.⁸⁴ Maintaining a rigid four-person staffing model compromises the fire department's ability to staff more apparatus without adding personnel. Research has shown that maintaining a rigid staffing policy may also drive up costs because overtime may be needed to fill unanticipated absences.⁸⁵ If operational policies allowed for flexible staffing guidelines, reducing the minimum staffing to three personnel as needed would offer the DFD the flexibility to operate with fewer personnel on the apparatus or reallocating personnel to suit employee availability.⁸⁶ Therefore, exploring alternative staffing models, such as a three-person minimum versus a four-person minimum, may help determine whether they can effectively optimize fire department operations.

The DFD collectively bargains with Dayton Firefighters Local 136 and in its role as sole bargaining agent for Dayton firefighters. As the sole bargaining agent, and

⁸³ National Fire Protection Association, *Standard 1710*.

⁸⁴ *Ibid.*

⁸⁵ Sierra, *From Twenty-Four to Something New, A Shift Away from the Traditional Work Schedule in the Fire Service*, Executive Fire Officer ed. National Fire Academy, 2001).

⁸⁶ *Ibid.*

desiring to “maintain effective operations in fire suppression,” Local 136 negotiated a fire-apparatus staffing article into the current collective bargaining agreement (CBA). Consistent with this agreement, all DFD fire apparatus are staffed with a minimum of one officer and three firefighters.⁸⁷ The DFD has 105 personnel allocated to each of its platoon shifts. After accounting for nonproductive time; i.e., scheduled and unscheduled absences, each platoon must have 65 personnel left to staff 12 fire apparatus with four people, seven medic units staffed with two personnel, two district chiefs, and one ISU (EMS supervisor).⁸⁸ When 65 personnel are not available, the department will then “brown out” one fire apparatus (company), which lowers its response capability to 11 fire apparatus for the day; the department can brown out up to one fire company before overtime is authorized to meet the minimum staffing of 11 fire apparatus.

Consequently, in 2013, the DFD operated with a browned out fire apparatus 75% of the time. Although browning out a fire apparatus is a temporary measure only impacting that particular firehouse on that day, it does impact the fire service delivery provided by the fire department. It takes longer to respond to emergencies that would have otherwise been covered by the browned out apparatus. This fact is significant given the dynamic nature of a fire and its exponential growth potential.⁸⁹ Outside jurisdictions are also impacted as they may be requested to provide mutual aid support to the DFD that may not otherwise be needed if they had not browned out the fire apparatus. The neighboring community’s resources are stressed as well when mutual aid assistance is often requested by Dayton.

Reducing the minimum staffing to three personnel may offer the flexibility needed to preclude the DFD from browning out a fire apparatus. Under the current four-person model, the DFD can only place 12 fire apparatus in service each day with 65 personnel. Reducing the minimum staffing to a three-person model can potentially free

⁸⁷ City of Dayton, *Agreement: The City of Dayton, Ohio and International Association of Firefighters, Local 136 A.F.L.-C.I.O.* (Dayton, OH: City of Dayton, 2012).

⁸⁸ Dayton Fire Department, *2014 Budget Presentation: General Fund Expenditures Report* (Dayton, OH: Dayton Fire Department, 2013).

⁸⁹ U.S. Fire Administration, Statistical Reports: Fire Departments, Topical Fire Report Series, “Fire Department Fire Run Profile.”

up 12 personnel to staff four additional fire apparatus. The additional apparatus has the potential to reduce response times, as more resources are thus available to respond from firehouses proximal to the emergencies. Additionally, more resources also reduce the need for mutual aid assistance from neighboring jurisdictions. Research has found that three-person crews are only minimally affected in their ability to perform the vital tasks of search and rescue and extinguishing fires. The literature shows that 14–15 critical tasks are required at every residential structure fire.⁹⁰ Of the critical tasks, getting water on the fire, and search and rescue activities, are the most prominent. A four-person crew is only 6% faster in getting water on the fire than a three-person crew, and only 5% faster at search and rescue.⁹¹ The performance difference between a four- and three-person crew is negligible and may be considered a manageable risk in exchange for staffing more fire apparatus.

Placing additional apparatus in service is limited by the number of reserve apparatus that a fire department may have available. The DFD has four reserve engines and four reserve ladder-trucks that offer the capability to place up to eight additional fire apparatus in service. These apparatus are already equipped and stored in firehouses throughout the city and ready to be placed in service. Each piece of reserve apparatus can be placed in service as a second fire apparatus in each firehouse, and thereby, enhance its response redundancy; i.e., when one of the fire apparatus responds to an emergency, the other fire apparatus in the firehouse is available to respond to subsequent alarms.

The DFD response redundancy is limited because only one fire apparatus is in service at each firehouse. Response districts within the city do overlap by offering limited redundancy but results in longer response distances and times. For example, at a recent fire fatality in the City of Dayton, the closest fire apparatus was on another incident and the first arriving apparatus took in excess of six minutes to reach the fire scene in what would have otherwise been a two-minute response.⁹² This number is significant because, when unabated by fire attack, a fire can spread beyond its room of origin. Over half the

⁹⁰ Hunt, “Making the Case,” 32–42.

⁹¹ Averill et al., “Report on Residential Fire Ground Field Experiments.”

⁹² Gokavi, “Woman Mourns Loved Ones Lost in Dayton Duplex Fire,” 1.

fires occurring in the United States are contained to the room of origin when the first apparatus arrived within six minutes of notification.⁹³ It has also been found that occupants rescued by quicker arriving crews have lower rates of smoke toxicity than those rescued by later arriving crews.⁹⁴ Therefore, more available fire apparatus enhances response redundancy that may reduce response times to structure fire scenes, and thus, lower the risk of smoke toxicity and mitigating fire damage.

Three-person staffing on fire apparatus is a strategy used by other fire departments. Toledo, Canton, and Columbus, Ohio fire departments all staff at least some of their apparatus with three personnel.⁹⁵ Toledo staffs its ladder-trucks with three personnel while its engines are staffed with four, Canton staffs its engines with three personnel and ladder-trucks with five, and Columbus staffs all its fire apparatus with three personnel until 8:00 pm and four personnel thereafter. These departments have staffing flexibility that affords them the ability to staff fire apparatus as they see fit to meet the demands of their communities. Without having their given staffing flexibility, these communities, like the DFD, would likely have to explore alternative strategies to meet their communities' needs. To maintain the same number of in-service fire apparatus would require more personnel, and thereby, increase their operating budget alternatively, without a budget increase, they would have to cut the number of available in-service fire apparatus to use the available personnel to staff the apparatus with four personnel.

This aforementioned scenario differs from fire departments, such as the DFD. The DFD is contractually obligated to staff its fire apparatus with four personnel, and with personnel costs covering over 80% of all fire department budgets,⁹⁶ increasing the number of in-service fire apparatus without adding to the operating budget is unlikely. Arbitrarily changing the minimum staffing to three persons would be a contract violation leading to the grievance and arbitration process. Given the clear language within the

⁹³ U.S. Fire Administration, Statistical Reports: Fire Departments, Topical Fire Report Series, "Fire Department Fire Run Profile."

⁹⁴ Averill et al., "Report on Residential Fire Ground Field Experiments."

⁹⁵ R. Braun (Cincinnati Ohio's Fire Chief), in discussion with the author, March 18, 2014.

⁹⁶ IAFF Firefighters, "Economic Decline Threatens Staffing, Benefits," 1.

contract, labor would likely prevail in its argument and staffing would have to be reverted to four-person staffing. An alternative path would be to request, and the local bargaining group agreeing to, a memorandum-of-understanding changing the staffing article language to reflect three-person staffing.

Consistent with the recommendation given in NFPA Standard 1710, the DFD staffs each fire apparatus with four people. According to NFPA 1710, four-person staffing is the optimal number of personnel who should be on board each fire apparatus for maximum efficiency and crew safety.⁹⁷ Moreover, OSHA enacted the two in/two out rule, which states that before entering an IDLH environment, at least two firefighters must be outside the environment before a crew of at least two personnel can enter the IDLH environment.⁹⁸ Therefore, with four personnel on board, two personnel can remain outside the IDLH environment while the other two can immediately engage in emergency operations inside the environment. Conversely, with less than four personnel on board, the first arriving apparatus would have to wait for another crew to arrive before actions in the IDLH environment could be initiated.

Research suggests that three-person staffing may also be counterproductive in increasing personnel availability. Research has found that fire departments that staff their fire apparatus with three personnel have higher rates of injury.⁹⁹ Increasing the number of injured personnel is counterproductive to any strategies that may be undertaken to increase personnel availability. Reducing the number of available personnel may increase the likelihood of having to brown out a fire apparatus should it be dictated by the number of injured firefighters. Therefore, any strategies employed that may increase absenteeism should be carefully considered.

The Austin, Texas Fire Department is similar to the DFD in the respect that it staffs all its fire apparatus with a minimum of four personnel. Prior to performing a four-year study analyzing the effects of increasing its fire apparatus-staffing model, Austin

⁹⁷ National Fire Protection Association, *Standard 1710*.

⁹⁸ United States Department of Labor, “OSHA Standard 1910.134(g) (4).”

⁹⁹ Ibid.

staffed its fire apparatus with three personnel. Its study found that its injury rates were 1.5 times lower with four-person crews.¹⁰⁰ To put this number in perspective, the DFD averaged 4.94 personnel off per day on injury leave between 2009 and 2013; reflecting on Austin's findings, the DFD could see its injury leave average rise to 7.26 personnel per day. Therefore, higher injury leave rates affect personnel availability and the number of staffed apparatus that can be staffed and available each day. It may also impact the personnel budget when overtime personnel are needed to backfill for the absences to staff the minimum number of apparatus.

Three-person crews have also been shown to be less effective in personnel-intensive incidents, such as high-rise fires. An experiment studying fire crew size found that it took 12 minutes longer for three-person crews to complete 14 critical tasks that must be completed at a high-rise structure fire.¹⁰¹ Critical tasks are those tasks are "undertaken when potential risks to building occupants and firefighters are greatest."¹⁰² Three-person crews accomplished all the tasks in one hour and two minutes while a four-person crew was capable of completing the same tasks in 50 minutes. High-rise structure fires are personnel intensive and reducing the number of personnel available upon their arrival compromises the incident commander's ability to accomplish the critical tasks necessary to bring the incident safely and effectively under control.

Compared to three-person fire apparatus staffing, four-person staffing provides higher levels of safety for firefighting personnel, better fire crew efficiency, and enhanced fire ground operations.¹⁰³ Four-person staffing on DFD fire apparatus is also consistent with NFPA Standard 1710 that recommends this level of staffing for safety and efficiency.¹⁰⁴ To be effective, NFPA 1710 also states that 15 firefighters should be on the fire ground to accomplish the 22 critical tasks at a low hazard/low risk structure

¹⁰⁰ Averill et al., "Report on Residential Fire Ground Field Experiments."

¹⁰¹ National Institute of Standards and Technology, "Landmark High-Rise Fire Study Evaluates Effectiveness of Crew Sizes, Elevator Use," April 10, 2013, http://www.nist.gov/el/fire_protection/high-rise-fire-study-041013.cfm.

¹⁰² Ibid.

¹⁰³ Averill et al., "Report on Residential Fire Ground Field Experiments."

¹⁰⁴ National Fire Protection Association, *Standard 1710*.

fires, such as a residential, single-family structure.¹⁰⁵ Such structures comprise the most common and deadly fires in the United States,¹⁰⁶ and the initial DFD response of three engines, a ladder truck, district chief, and ISU provides 18 personnel, which exceeds the 15-person recommendation. Otherwise, with three-person staffing, the incident commander would have to request additional fire crews to respond to meet the recommended 15-person minimum.

Exploring peak-usage strategies that utilize three- and four-person staffing may be an effective compromise that offers the versatility of four-person staffing during periods of peak structure fire severity, and three-person staffing during periods of peak fire occurrence. Research shows that over 50% of structure fires occur between the hours of 12:00 pm and 9:00 pm.¹⁰⁷ Accordingly, an effective strategy for the DFD may be to increase the number of available in-service fire apparatus until 9:00 p.m. by removing the fourth person off each fire apparatus and recombining them to staff additional fire apparatus during this time period. Staffing the available reserve fire apparatus already housed in the firehouses enhances response redundancy, and when responding together, immediately provides six personnel on the scene to initiate firefighting activity while still being compliant with OSHA's two-in/two-out rule.¹⁰⁸

After 9:00 pm, the extra apparatus may be taken out of service and the personnel re-assigned to other fire apparatus forming four-person crews. Similarly, the Columbus, Ohio Fire Department staffs its fire apparatus with three personnel until 8:00 p.m. and adds a fourth person thereafter because fire severity is higher throughout the night hours. Research shows that fire severity is higher between 4:00 am and 5:00 am when fires often

¹⁰⁵ Hunt, "Making the Case," 32–42.

¹⁰⁶ National Institute of Standards and Technology, "Landmark Residential Fire Study Shows How Crew Sizes and Arrival Times Influence Saving Lives and Property," April 28, 2010, http://www.nist.gov/el/fire_research/residential-fire-report_042810.cfm.

¹⁰⁷ U.S. Fire Administration, Statistical Reports: Fire Departments, Topical Fire Report Series, "Fire Department Fire Run Profile."

¹⁰⁸ Occupational Safety and Health Administration, "OSHA's Respiratory Protection Standard, 29 CFR 1910.134."

grow undetected, which results in delayed notification.¹⁰⁹ Staffing all fire apparatus with four personnel during periods of peak structure fire severity may be an effective strategy to ensure more personnel are on the fire ground to address the critical tasks associated with structure fires.

B. ANALYSIS OF THE THREE-PERSON STAFFING ALTERNATIVE

An analysis of the data and evidence suggests “pros” and “cons” for fire departments staffing their fire apparatus with three personnel instead of four. The “pros” for this schedule lie in its cost, legality, political acceptability, effectiveness and efficiency.

Reducing the minimum staffing policy from four to three personnel on a fire apparatus may also lower operating costs, which allows the fire department to staff additional fire apparatus without increasing personnel costs. Under the current model, firefighters may be called in on overtime and be compensated at 1.5 times their normal pay rate to backfill an absence to maintain four-person staffing.

Fire departments may enhance their effectiveness by distributing personnel into three-person crews to allow more apparatus to be staffed. The additional apparatus enhances response redundancy by adding a second fire apparatus that can respond when the other fire company is unavailable. Response times and distances are reduced when fire apparatus are available to respond from within their own response district. Reduced response time and distance may mitigate fire damage and smoke toxicity risk.

Three-person crews may also perform fire emergency activities effectively without a significant performance drop compared to four-person crews. The time difference between three- and four-person crews to complete search and rescue, and fire extinguishment assignments, is negligible.

Additional fire apparatus may efficiently use its available personnel by taking the fourth person off each apparatus and recombining them to form three-person crews. For

¹⁰⁹ U.S. Fire Administration, Statistical Reports: Fire Departments, Topical Fire Report Series, “Fire Department Fire Run Profile.”

example, the DFD could take one person from each of its 12 fire companies and recombine them to form four additional three-person crews, which increases the level of service provided to the public in the form of additional in-service fire apparatus without increasing personnel expenses.

Fire service delivery may also be more efficient when staffing is managed in response to peak usage periods. The number of in-service fire apparatus may be increased or reduced in response to the peaks usage environment. This number may offer the flexibility to staff more fire apparatus with three-person crews between 12:00 pm and 9:00 pm to accommodate busier fire activity periods.

Conversely, run volume slows down after 9:00 pm but fire severity is higher. The most severe fires occur between 4:00 am and 5:00 am because most people are at home, which results in a delayed notification and fire response. Since most people are home during these hours, the probability of a rescue situation also increases. Therefore, it may be a more appropriate time to have fewer crews with more personnel per apparatus who can accommodate the need to accomplish more fire ground assignments, such as search and rescue.

Elected governments may find alternative staffing strategies as means to provide a higher level of service to the public without having to allocate more funds to their operating budget. This alternative enhances their image before their constituents. Other large fire departments, such as Columbus, Toledo, and Canton, Ohio, already have a three-person minimum staffing policy in place. This staffing policy may offer the elected government a level of comfort that this strategy change can be employed successfully and safely to the public.

Legality is not a consideration when changing the staffing model to a three-person minimum. Changing to a three-person staffing model is a legal and acceptable strategy employed by other fire departments to optimize their fire department operations. NFPA 1710 Standard on staffing apparatus with four personnel is merely a recommendation and does not force fire departments into compliance.

The data and evidence suggests that the three-person staffing model also has “cons” that should be considered. These negative aspects may be found in additional costs, political acceptability considerations, questionable legality, reduced effectiveness, and less efficient fire resource allocation.

Literature suggests that three-person staffing may increase the level of injury rate occurrence in comparison to four-person crews. Injury rate increases will also drive up health care costs and the amount of overtime needed to backfill injury leave absences. These increases may effectively counter other strategies employed to increase employee availability.

The local bargaining group considers four-person staffing to be an issue that directly impacts the safety of its membership. This issue is reflected by its negotiating a staffing article into the current CBA that requires a minimum staffing of four personnel on all fire apparatus. It is unlikely that it will be willing to agree to reduce the minimum staffing article and will apply political pressure to Dayton’s elected body as needed to make its concerns known. Moreover, in their capacity as a political entity, local bargaining groups can lobby the local government over their concerns for firefighter safety and effectiveness.

The legality of reducing staffing minimums is also questionable when they are part of a collectively bargained agreement. When four-person fire apparatus staffing is a negotiated article in the CBA, then the fire department cannot change staffing levels without renegotiating the contract article. The local bargaining group would likely be successful in having the local court system place a “temporary restraining order” on the staffing changes that would stop further action until it can be heard under grievance and arbitration processes.

Three-person staffing has also been found to be less effective than four-person crews in accomplishing the critical tasks associated with high-rise fires. High-rise structures are heavily personnel intensive incidents and it takes three-person crews 12 minutes longer to complete the 14 critical tasks of a high-rise fire than a crew possessing more personnel.

Three person crews are also less effective when having to wait for additional crews to arrive at fire scenes. Often this delay is necessary to comply with the DOL's two-in/two-out rule; crews must have two personnel outside standing by while two firefighters are inside an IDLH environment.¹¹⁰ These delays may significantly increase fire propagation, hinder rescue efforts and increase risk to firefighters.

NFPA Standard 1710 recognizes that three-person crews are less efficient than four-person crews. For example, a four-person crew can be split into two operational teams, whereas a three-person crew can only operate as one team in an IDLH environment. For this reason, four-person crews can complete all structure fire critical tasks faster than three-person crews.

Also under current dispatching protocols, the DFD exceeds NFPA 1710's recommendation to have 15 firefighters on the scene at structure fire incidents. The DFD's structure fire response includes three engines, one ladder-truck, one ISU, and one District Chief. With three-person staffing, an additional fire company will have to be dispatched to meet the 15-person minimum recommendation.

After reviewing, consolidating, and eliminating the cons, the following set of issues can be considered.

- Three-person crews are less efficient and effective than four-person crews during structure fires. For safety reasons, a fire crew works in a minimum of two-person teams; therefore, a four-person crew can split up into two-two person teams. Conversely, a three-person crew can only work as one team in an IDLH environment, which thus, makes them less efficient.
- Four-person crews are also more effective at high-rise fires at which completing the 14 critical tasks places undue risk upon firefighters and occupant safety if not otherwise completed.
- Under current DFD dispatching protocols for structure fires, fire response is less efficient because more apparatus are required on the scene to meet NFPA 1710's 15-firefighter recommendation. An additional apparatus will have to be added to all structure fire dispatches to meet the NFPA standard.

¹¹⁰ United States Department of Labor, "OSHA Standard 1910.134(g) (4)."

- Costs are higher and less efficient with three-person crews. Injury rates are higher for three-person crews that will drive up workers' compensation and health care costs. Higher injury leave rates may also reduce the number of personnel available to staff fire apparatus each day. Injuries rates leading to absences may also increase overtime costs when needed to meet the minimum daily personnel availability.
- The legality and political acceptability of employing a three-person staffing model may be suspect. The local bargaining unit is unlikely to compromise on the four-person-staffing article; therefore, renegotiating for a three-person staffing model is unlikely. Unilaterally changing the minimum staffing to three personnel is a direct violation of the current CBA, which would trigger a legal process in which an arbitrator would likely rule against the DFD and stop the change.

Once the issues have been identified, they are analyzed and the following measures are taken to neutralize as many negative issues as possible by converting them to positive issues. Table 8 is derived from an assessment of the pros and cons of the current DFD work schedule.

Cons	Fixes
Effectiveness and Efficiency: Three-person crews are less effective than four-person crews during structure fires. For safety reasons, fire crews work in a minimum of two-person teams; therefore, a four-person crew can split up into two-two person teams. Conversely, a three-person crew can only work as one team in an IDLH environment, which thus makes them less efficient.	No fix—firefighters working by themselves are more at risk and are less effective than a two-person crew.
Effectiveness: High-rise fires are personnel intensive incidents and three-person crews take 12 minutes longer than four-person crews to complete 14 critical tasks that place risk upon firefighters and occupant safety if not otherwise completed.	Can be mitigated by requesting that additional fire crews be dispatched to the incident, which will increase the number of firefighters to accomplish all critical tasks in a timely manner.
Cost and Efficiency: Injury rates are higher for three-person crews that will drive up workers' compensation and health care costs. Higher injury leave rates may also reduce the number of personnel available to staff fire apparatus each day. Injuries rates leading to absences may also increase overtime costs when needed to meet the minimum daily personnel availability.	Requesting additional apparatus to structure fires will provide more firefighters to accomplish critical tasks possibly mitigating injuries caused by overexertion.

Cons	Fixes
Political Acceptability and Legality: The local bargaining unit is unlikely to compromise on the four-person staffing article; therefore, renegotiating for a three-person staffing model is unlikely. Unilaterally changing the minimum staffing to three personnel is a direct violation of the current CBA, which will trigger a legal process in which an arbitrator will likely rule against the DFD and stop the change.	No fix—the local bargaining group will likely be unwilling to compromise their strong beliefs on the safety value brought forward by four-person staffing.
Efficiency: Under current DFD dispatching protocols for structure fires, three-person crews will not meet NFPA 1710’s recommendation for a 15-firefighter response to structure fires. An additional apparatus will have to be added to all structure fire dispatches to meet the NFPA standard.	Change dispatching protocols to add one more fire apparatus to structure fire responses.

Table 8. Cons and Fixes for Three-Person Staffing Alternative

This analysis suggests that three of the cons can be mitigated and two cannot be fixed at all. According to Morgan Jones, the DFD would have to be willing to bear these burdens when employing a three-person staffing model. Three-person staffing may offer an opportunity to staff more fire apparatus, and possibly, lead to faster response times. However, the two-in/two-out rule and NFPA 1710 compliance, higher overtime costs and injury rates, inefficient three-person crew operations, and the local bargaining unit’s likely objection to three-person staffing, are unacceptable burdens to bear.

C. SUMMARY

The DFD currently employs a four-person staffing model on all its fire apparatus that is compliant with NFPA Standard 1710 and the Department DOL’s two-in/two-out rule. Furthermore, the local bargaining unit, recognizing the safety and efficiency value of four-person staffing, has successfully negotiated this staffing as a minimum staffing article into the current CBA.

Three-person staffing offers many benefits to the organization otherwise unattainable under the current staffing model. The number of staffed apparatus each day is reliant upon the number of available personnel; therefore, if management had the

flexibility to staff with three persons, the balance of the personnel can then be redistributed into three-person crews staffing additional personnel. Additional apparatus increases response redundancy when multiple fire apparatus are colocated in firehouses to allow a reduction in response times and distances that may not be otherwise available.

Peak usage staffing may also be an alternative strategy benefitting from three-person staffing. Apparatus can be staffed with three personnel during the high-volume run periods prior to 9:00 pm and with four personnel thereafter. Fires tend to be more severe during the overnight hours because of the delayed notification and fire department response; therefore, the efficiency and safety benefits offered by a four-person crew may benefit firefighting activity during this period.

On the other hand, three-person staffing has been shown to increase injury leave rates, which increase the costs associated with workers' compensation benefits and health care coverage, as well as the overtime costs associated with backfilling these personnel. Three-person staffing is also noncompliant with NFPA Standard 1710 and the DOL's two-in/two-out rule that focuses on the safety and efficiency benefits of having four personnel assigned to each crew. It has been found that three-person crews take longer to accomplish the critical tasks associated with the structure fires and considering the dynamic growth potential of structure fires, the fire may potentially grow , which inhibits critical lifesaving actions.

The alternative staffing option has been evaluated and summarized as illustrated in Table 9.

Policy	Cost	Legality	Political Acceptability	Effectiveness	Efficiency	Recommend Implementation
Alternative Staffing Model	High	No	No	Yes	Yes	No

Table 9. Evaluation Criteria for the Alternative Staffing Policy Option

VII. REDUCING NONPRODUCTIVE TIME

A. DATA AND EVIDENCE

Reducing nonproductive time, such as sick and injury leave usage, may optimize fire department operations by increasing personnel availability and its ability to staff more fire apparatus without increasing the operating budget. Therefore, nonproductive time reduction strategies are worthy of further analysis for potential new policy implementation.

Workplace wellness programs are a six billion dollar industry with over one-half of all companies with more than 50 employees offering these programs.¹¹¹ Research has shown that wellness programs have been effective in reducing absenteeism, and thereby, increasing employee availability.¹¹² Wellness programs may also be cost effective; in a study by the Rand Corporation, its research suggests that disease management programs realize a \$3.80 ROI for every dollar invested into the program.¹¹³ The study also evaluated the lifestyle management component that addressed lifestyle issues, such as smoking and diet, and found that it offered a smaller \$.50 ROI. Furthermore, when combined, lifestyle and disease management programs reduced employer health care costs by \$30 per member per month.¹¹⁴

Disease management includes health considerations, such as cardiac conditions, diabetes, and high blood pressure, all of which can drive up health care costs and can also affect an employee's quality of life. Heart disease is the leading cause for firefighter line-of-duty deaths.¹¹⁵ Mitigating this risk through wellness programs would therefore benefit the employees and their fire department. As a component of disease management, a

¹¹¹ Soeren Mattke et al., *Do Workplace Wellness Programs Save Employers Money?* (Santa Monica, CA: Rand Corporation, 2014).

¹¹² *Ibid.*

¹¹³ *Ibid.*

¹¹⁴ *Ibid.*

¹¹⁵ Rita Fahy and Paul R. Leblanc, "Firefighter Fatalities in 2000," *NFPA Journal* 95, no. 4 (2001): 66–79; IAFC, IAFF, *The Fire Service Joint Labor Management Wellness/Fitness Initiative* (Washington, DC: International Association of Fire Fighters, 2000).

wellness program provides an opportunity for early identification of life altering conditions, such as cardiac disease, which benefits the employees and the employer. The employees' quality of life is enhanced because they may be able to seek early treatment for a potentially deadly condition. The employer benefits because, if caught early, employees' death or long-term disability may be averted to allow employees possibly to return to work earlier than they may have otherwise.

Obesity is another condition that can positively benefit from wellness programs. Obesity affects over 33% of the U.S. population; in comparison, over 70% of firefighters are considered to be obese.¹¹⁶ Obese and overweight firefighters miss between 2.7 and 5 times more work time than firefighters of normal weight, which increases illness and injury costs, and reduces employee availability.¹¹⁷ Therefore, addressing this problem through wellness programs may be effective in reducing nonproductive time. Obesity has been found to be related to or contributes to a number of high-risk factors for heart disease, such as hypertension and diabetes, and obese workers are 70% more likely to experience high levels of absenteeism.¹¹⁸ Compared to normal weight firefighters, obese firefighters cost their fire departments over sixteen hundred dollars more per firefighter because of missed duty days related to injuries.¹¹⁹ Obesity is also an independent risk factor for cardiovascular disease (CVD).¹²⁰ This factor is a particularly salient point with over half of firefighter deaths being attributed to heart attacks. Research shows that fire departments are experiencing high levels of service-related injuries that may benefit from wellness programs.¹²¹

Fire service wellness programs have been found to be cost effective in reducing sick and injury rates and controlling the costs associated with replacing firefighters.¹²²

¹¹⁶ Christopher Keith Haddock, Walker S. C. Poston, and Sara A. Jahnke, *Addressing the Epidemic of Obesity in the United States Fire Service* (Greenbelt, MD: National Volunteer Fire Council, 2011).

¹¹⁷ Ibid.

¹¹⁸ Ibid.

¹¹⁹ Ibid.

¹²⁰ Ibid.

¹²¹ IAFC, IAFF, *The Fire Service Joint Labor Management Wellness/Fitness Initiative*.

¹²² Ibid.

After accounting for workers' compensation benefits, other insurance expenses (including long-term care), lost productivity, and the administrative costs of insurance, the estimated cost of addressing firefighter injuries comes to 2.8–7.4 billion dollars per year.¹²³ The West Metro Fire Protection District, whose run volume and department size is similar to that of the DFD, has saved over one million dollars in insurance premiums since implementing its wellness program four years ago.¹²⁴ Implementing a wellness program in Dayton has the potential to improve employee availability by ensuring coverage for absent employee or to staff additional fire apparatus. The DFD has averaged nearly five firefighters on injury leave per day between 2009 and 2013, and averaged an additional five firefighters off sick each day in 2013;¹²⁵ together, a wellness program has the potential to improve personnel availability. As personnel availability improves, the DFD can staff an additional fire apparatus for every four people who would otherwise be sick or injured. These efficiencies optimize fire service delivery without increasing the operating budget.

NFPA 1500 Standard on Fire Department Occupational Safety and Health Program recommends that fire departments develop physical requirements for candidates and members that include annual physical evaluations; those not passing the evaluation must participate in a “physical performance rehabilitation program to facilitate progress in attaining a level of performance commensurate with the individual’s assigned duties and responsibilities.”¹²⁶ This program benefits the employee and employer by identifying health conditions early that may otherwise result in long-term disability or death. Although NFPA 1500, like all NFPA standards, are merely recommendations for fire department operations, they offer guidelines for fire department operations.

¹²³ National Institute of Standards and Technology, *The Economic Consequences of Firefighter Injuries and Their Prevention: Final Report*. Gaithersburg, MD: National Institute of Standards and Technology.

¹²⁴ Hawkes, “Evaluation of the 48–96 Shift for West Metro Fire Rescue.”

¹²⁵ City of Dayton, *Internal Report, Injury Leave Usage* (Dayton, OH: City of Dayton, 2014).

¹²⁶ National Fire Protection Association, *NFPA Standard 1500* (Quincy, MA: National Fire Protection Agency, 2010).

In consideration of NFPA Standard 1500, the International Association of Firefighters (IAFF) and the International Association of Fire Chiefs (IAFC) have collaborated to develop a firefighter specific wellness program titled WFI.¹²⁷ This collaborative effort between labor and management is intended to strengthen firefighters' mental, physical, and emotional capabilities, so that they are more resilient and capable of coping with the physical and psychosocial stressors.¹²⁸ With almost half of firefighter injuries being sprains and strains attributed to fire ground activity,¹²⁹ it becomes particularly important to evaluate and improve employee fitness. This effort illustrates the value labor and management places on the health and welfare of firefighters.

Fire departments absorb direct costs, such as lost work time, higher worker compensation premiums, and overtime expenses to backfill for the absence; therefore, adopting the WFI may be beneficial in reducing nonproductive time. Human capital is a fire department's most precious resource, and like all resources, the WFI is an investment with a return of sick and injury leave reductions and lower costs.

The WFI is a comprehensive health and wellness program that assesses and treats the physical and psychosocial stressors often experienced by firefighters. Research shows that fire departments adopting the WFI reduced their nonproductive time by 28% and workers' compensation claims costs declined by 23%.¹³⁰ These results are conservative in nature when considering they only evaluate work-related injuries and claims; the value could be even more substantial when factoring in nonduty related conditions and implementing early screenings that detect diseases, and thus, mitigate their impact.¹³¹

On the other hand, fire departments will also have to consider the up-front and continuing costs for implementing wellness programs. Research shows that it will cost approximately \$930 per firefighter in startup costs during the first year of implementation

¹²⁷ IAFC, IAFF, *The Fire Service Joint Labor Management Wellness/Fitness Initiative*.

¹²⁸ Ibid.

¹²⁹ Ibid.

¹³⁰ Ibid.

¹³¹ Ibid.

and \$520 per firefighter per year thereafter.¹³² Although it has been found that their return on investment may be \$1.50 for every \$1.00 invested in the program,¹³³ implementing the program may be cost prohibitive and contingent upon budgetary constraints. Furthermore, employees distrust their employers having access to their health information and this distrust may impact how well they receive the implementation of a wellness program.¹³⁴ If the wellness plan is not conveyed as an individualized, nonpunitive process that judges their progress against past years, then employees may consider these programs as a means to discharge them if they are found to have health conditions making them unfit for firefighting duty.

B. ANALYSIS OF REDUCING NONPRODUCTIVE TIME THROUGH WELLNESS PROGRAMS

An analysis of the data and evidence suggests “pros” and “cons” for fire departments implementing wellness programs to reduce nonproductive time. The “pros” for this schedule lie in its efficiency, effectiveness, legality, and political acceptability.

Wellness programs are cost efficient in their ability to save companies almost \$4.00 in health-related expenses and absences for every dollar invested into the program. After the initial investment in start-up costs associated with program implementation, research suggests that savings will be sufficient enough to pay for the program thereafter.

Wellness programs have been found to be efficient in controlling personnel costs that result from having to replace injured and ill firefighters with backfill overtime personnel. Long-term disabilities associated with injuries and health conditions may be mitigated by the benefits offered through disease and health management strategies.

Wellness programs have been found to be effective in reducing absenteeism, and thereby, increase employee availability. Enhanced employee availability optimizes fire

¹³² Ibid.

¹³³ Mattke et al., *Do Workplace Wellness Programs Save Employers Money?*

¹³⁴ Jeremy Smerd, “Financial Health Incentives on the Rise, but Design is Key,” *Workforce Management* 87, no. 11 (June 23, 2008): 14–14.

department operations by making more employees available to staff additional fire apparatus without the expense of overtime.

Wellness programs have been found to be effective in addressing cardiovascular disease by reducing obesity in the fire service. Heart attacks have been identified as the most common cause of firefighter death during emergency operations; obese firefighters miss up to five times more work time than those firefighters of normal weight, which exacerbates health and injury costs, and reduces employee availability. Addressing these issues may effectively reduce firefighter deaths and long-term disability incidents, and benefits the fire department through reduced health care costs and earlier return to duty for injured and sick firefighters.

Implementing a wellness program is legal as long as patient-doctor confidentiality is kept in accordance with Health Information Portability and Accountability Act (HIPAA) rules.¹³⁵ The rehabilitation component is nonpunitive in nature with the only goal being an employee's successful rehabilitation and return to duty.¹³⁶

Accepting a wellness program benefits the community, and therefore, the local elected government may find its adoption to be politically acceptable. The community benefits through lower operating costs for its fire department. The local government may also see the benefit of a reduced reliance on outside jurisdictions assisting its fire department.¹³⁷ NFPA Standard 1500 is the nationally recognized recommendation that all fire departments use as a guideline when developing safety standards. Included in this standard is the recommendation that all firefighters receive annual physical assessments. This standard supports fire department efforts in wellness programs validating their implementation.

¹³⁵ U.S. Department of Health and Human Services, "The Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy, Security and Breach Notification Rules," accessed May 29, 2014, <http://www.hhs.gov/ocr/privacy/>.

¹³⁶ IAFC, IAFF, *The Fire Service Joint Labor Management Wellness/Fitness Initiative*.

¹³⁷ *Ibid.*, 8.

The data and evidence suggests that adopting wellness programs to reduce nonproductive time also has “cons” that should be considered. These negative aspects may be found in additional costs and political acceptability.

Start-up and maintenance costs for implementing the plan may be cost prohibitive within the budgetary constraints of the fire department. Startup costs including baseline physicals for all employees, purchasing fitness equipment, and administrative costs can exceed a value of \$900 per employee. Ongoing maintenance costs, such as periodic physicals and equipment maintenance, will cost the fire department over \$500 per firefighter in subsequent years.

Even though in time it may pay for itself, city management may find it fiscally difficult to establish funding for a wellness program. During times of lean budget years, a wellness program may be considered an extravagance it is ill prepared to accept. Furthermore, even if it does receive funding, it may be targeted for elimination in subsequent years as tight budgets occur. Given its long-term vision for improving employee health and reducing leave usage, wellness programs may not immediately realize their rewards, which may make them vulnerable to budget cuts.

Wellness programs may also be vulnerable to political turmoil within the fire department. Employees may not be accepting of a wellness program and may think that it can serve as a means to discharge employees for failing periodic assessments. It may take time, consistent adherence to confidentiality, and nonpunitive consideration for rehabilitation to build trust within the department.

Once the issues have been identified, they are analyzed and the following measures are taken to neutralize as many negative issues as possible, by converting them to positive issues. Table 10 is derived from an assessment of the pros and cons of the current DFD work schedule.

Cons	Fixes
Costs: The annual and on-going costs of maintaining the wellness program may be cost prohibitive under the constraints of the fire department's annual budget. Startup costs including baseline physicals for all employees and purchasing fitness equipment can exceed a value of \$900 per employee. Ongoing maintenance costs, such as periodic physicals and equipment maintenance, will cost the fire department over \$500 per firefighter per year	The substantial start-up costs may be difficult to achieve but it has been found that the return on investment thereafter will pay for the program
Political Acceptability: Employees may not be accepting of a wellness program and think that it may serve as a means to discharge employees for failing periodic assessments. This lack of acceptance may impact the success of this program because of the employees' belief that they may be relieved of their duties and career	Developing employee trust will be difficult to overcome. With time, as the fire department heeds HIPAA rules for patient confidentiality, the wellness program may become more accepted within the workplace

Table 10. Cons and Fixes for Reducing Nonproductive Time through Wellness Programs

This analysis shows that both the cons can be mitigated. Although the upfront costs can be substantial, in subsequent years, the return on investment will reduce medical expenses, illnesses, and injury leave claims. The second con can be mitigated in time as personnel gain confidence in management's ability to treat medical results in a nonpunitive and confidential manner.

Reducing nonproductive time, such as sick and injury leave, can be expected when implementing wellness programs, and thereby, optimize fire department operations. Illnesses and injuries may be reduced, which may improve employee availability to allow more fire apparatus to be staffed without increasing the operating budget. As stated earlier, wellness programs can reduce nonproductive times by 28%, which may be

enough to prevent browning out an apparatus, and thereby, enhance fire service delivery. The community benefits because of a reduced reliance on mutual-aid assistance from adjoining communities, and also as a result of a quicker response time by available in-service apparatus.

C. SUMMARY

Implementing a wellness program to reduce nonproductive time may be able to enhance fire service delivery by increasing employee availability, and subsequent capability, of staffing additional resources. It has been shown that wellness programs may be effective in reducing nonproductive time resulting from illnesses and injuries. Employees also benefit from these programs because early detection of a life altering health condition may improve the employee's quality of life, and with rehabilitation services, may even result in the employee's return to duty. Without early detection, some illnesses and diseases may lead to tragic results. Not implementing a wellness program may be devastating to the employee and the organization.

Wellness programs have also been shown to be cost efficient. Although the start-up costs can be daunting, its ROI may potentially pay for itself in subsequent years. A wellness program, by minimizing the number and duration of employee absences, helps control the operating costs by reducing dependency on backfill overtime coverage.

Disease management components of wellness programs have been shown to be effective in managing chronic health conditions, such as diabetes, CVD, and high blood pressure. Over half of firefighter deaths occurring on the fire ground are the result of heart attacks; therefore, effective disease management programs can positively impact the employee and organization. In addition to managing possible lethal health conditions, if caught early, disease management and early screenings can also minimize the length of absence of an employee seeking treatment for the condition. Wellness programs may also reduce health care expenses and lower the risk-rated premium payments for workers' compensation coverage.

NFPA 1500 Standard on Fire Department Occupational Safety and Health Program recommends annual physical assessments for the safety and benefit of firefighters. By supporting and recommending annual assessments, NFPA 1500 validates the appropriateness of wellness programs, which enhances its political acceptability within the local bargaining group and employees; it also establishes a framework for wellness programs.

Employees distrust their employers especially when it concerns health conditions that may jeopardize their career. Employees' distrust may be a significant hurdle for the organization to overcome for the success of a wellness program. The intent of wellness programs is to strengthen employee mental, physical, and emotional capabilities so that they are more resilient and capable of coping with stresses and strains that accompany life in the fire service. Therefore, wellness programs must be individualized, nonpunitive programs that compare current results against past performance and aftercare confidentially addressed between the physician and employee.

The wellness initiatives to reduce nonproductive time option has been evaluated and summarized as illustrated in Table 11.

Policy	Cost	Legality	Political Acceptability	Effectiveness	Efficiency	Recommend Implementation
Health and Wellness Initiative	High	Yes	No	Yes	Yes	Yes

Table 11. Evaluation Criteria Wellness Initiative Implementation

VIII. CONCLUSIONS, RECOMMENDATIONS, AND IMPLEMENTATION STRATEGY

Research suggests that over one half of the fire departments in the United States believe they are underfunded. While operating budgets continue to fall, public demand may not, and in the DFD's case, it may even rise. A review of the applicable research suggests that the DFD is a microcosm of an industry-wide problem in which fire departments across the country have seen their operating budgets cut because of fiscal crisis. Fire departments, as a result of insufficient funding and budget cuts, are resorting to strategies that reduce the amount of resources available to respond to emergencies. Fire departments are closing firehouses and browning out fire apparatus to meet their operating budget parameters. As personnel are retiring, becoming injured, and ill, their agencies are staffing fewer apparatus rather than hiring overtime to backfill for absences. All these methods are in essence reducing the level of fire service compared to that, which existed before budget reductions.

Furthermore, fewer personnel and apparatus may undermine a fire department's ability to meet NFPA emergency response time guidelines and the DOL's two-in/two-out rule; i.e., operational guidelines put in place to establish response time standards and safety protocols for fire departments across the nation.

Rather than reducing fire service levels as operating budgets drop, fire departments should endeavor to meet or improve service levels through enhanced operational efficiencies. Implementing a 48/96 work schedule, modifying apparatus staffing models, and reducing nonproductive time, have the potential to manage operations without reducing fire service delivery.

The 48/96 schedule and health and wellness initiatives may reduce nonproductive time, and as a result, optimize personnel availability. Reducing the minimum staffing on fire apparatus from four to three personnel allows the fire department to be flexible with its personnel by moving the fourth person where needed to staff additional apparatus. Analyzing these recommendations may serve as a case study in which sufficient research may be conducted to understand the issues at hand thoroughly, offer potential policy

change alternatives, and to provide a testing ground in which the policy changes can be thoroughly evaluated.

A. SUMMARY OF ANALYSIS

1. Schedule Modification

The 48/96 work schedule is similar to the 24/48-work schedule currently used by the majority of U.S. fire departments, including the DFD. It is similar in that both schedules offer a 1:2 duty-day to off-duty ratio that exceeds the 3:4 ratio recommended to prevent cumulative fatigue and sleep debt.

Sleep deprivation is a concern for that must be addressed for fire departments that employ both the 24/48 and 48/96 schedule. However, in comparison, the 48/96 schedule doubles the continuous duty hours and exacerbates sleep deprivation. Unaddressed, sleep deprivation has the potential to increase nonproductive time because of fatigue-related injuries. Reasoning and cognitive skills may also be affected by sleep deprivation and lead to poor performance and employee behavior. Sleep deprivation is a manageable concern that can often be addressed during an employee's duty time. Research suggests that a continuous five-hour block of sleep, when coupled with a separate 90-minute completion sleep before the second 24-hour duty, may mitigate, or even eliminate, the immediate effects of sleep deprivation.

Changing to the 48/96 work schedule has benefitted both fire department organizations and their employees. This schedule doubles the amount of time between duty days, which benefits the emotional, mental, and psychological needs of the employee. Whereas an employee on the 24/48 schedule will only be able to sleep late one out of three days, the 48/96 schedule affords the employee two days to sleep late. This schedule also allows more continuous time for leisure and to engage with family. Other benefits to this schedule are more continuous off-duty time to recuperate and rest between duty days. These benefits may positively affect an employee's mental, emotional, and psychological stressors.

The 48/96 schedule will be cost-neutral in comparison to the 24/48 schedule; both schedules are a 1:2 ratio and do not require additional personnel. Research has suggested

that the 48/96 schedule has even lowered health care and overtime costs. Fire departments have seen their sick and injury leave usage drop, which reduces backfill costs and health care needs related to the absence. The hours worked across a 28-day FLSA cycle will remain the same, and when implementing Kelly days, firefighter work hours are still compliant with FLSA rule 7(k). Under the FLSA, employers must pay their employees overtime wages for time worked in excess of a 40-hour workweek. However, firefighters are exempted from this provision of the FLSA and are not paid overtime wages until they work more than 53 hours in a 7-day period. Collective bargaining agreements can be more generous than the 7(k) exemption but cannot be more restrictive. For example, consistent with the current CBA, DFD firefighters are paid at an overtime rate whenever their duty shift exceeds 24 hours.

U.S. fire departments changing to the 48/96 schedule have also found that their sick and injury time usage has declined. Reducing sick and injury leave usage reduces health care costs and increases employee availability. Higher availability levels allow fire departments to maintain apparatus staffing that may otherwise require overtime personnel to backfill absences. Consistent with FLSA laws and the CBA, backfill personnel must be paid at a premium pay rate of 1.5 times their normal rate, which drives up operating costs for the fire department. Enhanced availability may also offer the department the opportunity to staff additional fire apparatus, and thereby, enable them to provide a higher level of fire service delivery without increasing operating costs.

2. Alternative Staffing Model

Four-person minimum staffing on fire apparatus is the staffing level recognized by NFPA Standard 1710. Although three-person crews are only slightly slower than four-person crews at getting water, and at search and rescue, four-person minimum crews complete all structure fire critical tasks significantly faster than three-person teams. Four-person crews at high-rise structure fires complete the 14 identified critical tasks in 52 minutes, whereas a three-person crew will take 64 minutes to complete the same tasks. In residential fires, four-person crews complete its 22 identified critical tasks in 15 minutes while it will take a three-person crew 20 minutes to complete the identical tasks. Four-

person staffing can also be deployed more efficiently at emergency scenes. Four-person crews can be split into two-two person teams, while smaller crews cannot without violating safety policies; i.e., when working in an IDLH environment, firefighters must operate in teams of no less than two persons. Four-person crews are also DOL's two-in/two-out rule compliant immediately upon arrival at structure fires. Three-person crews, on the other hand, must wait for additional resources to arrive before they can be compliant.

Most firefighter injuries in the fire service occur while working at emergency scenes. Often, the injuries are the result of overexertion as firefighters complete assigned tasks. Reducing the crew size will exacerbate this occurrence, as fewer personnel will be available to perform the critical tasks associated with structure fires. Any cost savings associated with reduced minimum staffing may be countered by higher health care costs, workers' compensation premiums, and overtime wages paid to backfill for injured employees. Fire departments must carefully assess the risk of increasing injuries against the benefit reducing the minimum-staffing policy.

Recognizing its positive safety and efficiency attributes, the local bargaining group has successfully negotiated four-person minimum-staffing into the current CBA. Failing to maintain four-person staffing on fire apparatus would violate the contract and lead to grievances, arbitration, and possibly, litigation. Therefore, departments, such as the DFD, that operate under contractually mandated minimum-staffing policies, may not be able to deploy flexible crew size models without renegotiating their contractual staffing articles.

Three-person minimum staffing does have positive attributes. It offers flexibility in fire department staffing to meet the needs of the community using the number of personnel available each day. For example, the DFD could staff additional fire apparatus by taking the fourth person off each fire apparatus and recombining them to form three-person crews. At the very least, reducing the minimum staffing to three persons may reduce the frequency at which a fire apparatus would have to be browned out. Costs may also be contained by minimizing, if not eliminating, the need for overtime back-fill personnel to maintain the 11 apparatus minimum complement.

Three-person minimum staffing may also offer the flexibility to staff apparatus to meet the demands of the public during periods of peak usage and fire severity. Most structure fires occur before 9:00 pm; therefore, having the flexibility to staff more fire apparatus may enhance the DFD's response redundancy and reduce apparatus response times and distances. Conversely, fire severity is higher throughout the night and early morning hours, and the safety and performance benefits of four-person crews may be significant.

3. Nonproductive Time Reduction through Wellness Programs

Wellness initiatives address the medical, physical, mental, rehabilitation needs for fire department employees. Reducing nonproductive time through wellness initiatives may be an effective strategy to improve employee availability, and thereby, optimize fire service delivery. It has been shown that wellness initiatives may be effective in reducing sick and injury leave, early detection of life altering health conditions, and rehabilitation. Furthermore, NFPA Standard 1500 recommends that fire departments provide annual physical assessments to all their personnel. Providing these assessments in conjunction with a broader wellness initiative provides a proactive approach benefitting employee welfare and the organization.

Reducing the occurrences of illness and injury may also be financially and operationally beneficial to the DFD. Health care costs, workers' compensation premiums tied to risk ratings, and backfill overtime wages, are all costs that wellness initiatives may lower or mitigate. As the occurrences recede, more personnel may reduce brownout occurrences within the DFD, and even potentially, increase availability to the point at which additional apparatus may be put in service.

Wellness initiatives are accompanied with substantial costs associated with program implementation. Professional services necessary to provide medical screenings, fitness programs, and data collection and tracking services may be accompanied by a daunting price tag for the fire department. However, it has been found that a \$1.50 ROI for every dollar spent on wellness programs can be realized when coupling disease management with lifestyle management programs' wellness initiatives.

The intent of wellness initiatives should be to strengthen employee mental, physical, medical, and emotional condition. Therefore, these programs should be individualized, nonpunitive programs designed to enhance organizational strength and employee health. Employees distrust their employers. As in the case of the DFD, the employees have the cynical belief that the current pulmonary function test is a means to terminate employees found unfit for duty. With time, a demonstrated practice of maintaining doctor/patient confidentiality, and promptly returning employees to their positions once rehabilitated, employers may gain the trust of their employees.

B. RECOMMENDATIONS

Policy alternatives, such as modifying the schedule to reflect a 48/96 rotation, reducing the minimum staffing on fire apparatus to three personnel, and reducing nonproductive time through wellness initiatives, have been introduced. Each policy alternative in itself, or in combination with each other, may effectively increase fire service delivery without increasing costs to the fire department. Currently, the DFD works within a 24/48-work schedule, staffs its fire apparatus with a minimum of four personnel, and only provides physical assessments as deemed necessary by the physician conducting the annual respiratory function-testing program. Each of these policy options has been judged on their effectiveness, efficiency, cost, legality, and political acceptability (see Table 12).

Policy	Cost	Legality	Political Acceptability	Effectiveness	Efficiency	Recommend Implementation
Status Quo	High	Yes	Yes	No	No	No
Schedule Modification	Neutral	Yes	Yes	Yes	Yes	Yes
Alternative Staffing Model	High	No	No	Yes	Yes	No
Health and Wellness Initiative	High	Yes	No	Yes	Yes	Yes

Table 12. Evaluation Criteria for Policy Options

Fire departments are facing budget crisis across the country. Personnel costs account for over 80% of a fire department's budget, and when mandated to cut costs, fire departments often reduce overtime staffing to meet their shrinking budgets. This number is notable because when overtime is cut, apparatus are then often browned out to match the number of available personnel each day. As an alternative to reducing fire apparatus, fire departments should consider improving personnel availability to reduce overtime needs.

Schedule modification and reducing nonproductive time may offer fire departments an opportunity to increase their personnel availability, and thereby, provide equal or better fire service without a corresponding increase in their operating budget. Both, although not completely positive in all judged criteria, have the highest chance of success in meeting these goals.

Schedule modification is a cost-neutral policy alternative. However, this schedule has been shown to reduce sick and injury leave usage and increase personnel availability. When used in concert with wellness programs, fire department operations may be optimized by offering a higher level of service while under budgetary constraints.

Implementing health and wellness initiatives may be costly to implement; however, given time, a wellness program's ROI may pay for itself and it may even save the department money. Sick and injury leave has been shown to decline with wellness programs, which saves the fire departments money in health care costs that also increases personnel availability.

On the other hand, minimum staffing is an article within the current bargaining agreement and will require negotiation with the local bargaining unit; the current agreement calls for a minimum of four-person staffing. Although modifying the current staffing model to a three-person minimum meets all the judged criteria, it falls short in political acceptability and legality. Three-person staffing allows for more apparatus to be staffed but may be negated by lower personnel availability resulting from higher injury leave usage. Sick and injury leave reductions resulting from schedule modifications and wellness programs may then be displaced.

The DFD should consider implementing a 48/96 work schedule and adopting health and wellness initiatives as policy options that may improve fire service delivery. Research suggests that each policy option may be able to increase personnel availability to staff additional fire apparatus, reduce sick and injury leave usage, lower health cost, and reduce workers' compensation premiums. Each of these policy options may optimize fire service delivery without increasing costs.

On the other hand, the DFD should not consider implementing a policy that would reduce its minimum-staffing model to three people. Literature shows a correlation between smaller crews and higher injury leave rates that could counter any benefits realized by the other two policy options. Three-person crews are also less efficient and effective on emergency scenes. Coupled with its political and legal volatility, the DFD may find policy implementation to be problematic.

1. Policy Implementation Limitations

Modifying the work schedule for the DFD will initially be limited in its implementation. This work schedule is untested by other area fire departments of similar size and structure, and therefore, a model is unavailable upon which to base its implementation. The schedule modification policy should be implemented as a pilot project to evaluate its success. As with other departments that have implemented this policy across the United States, a one-year trial should be considered with labor and management both having opt-out clauses in the agreement to enable either side to stop the trial should conditions or costs become untenable. It will be crucial for the DFD to evaluate its success, or lack thereof, to determine whether it will be a viable option.

Implementing wellness initiatives to reduce nonproductive time (sick and injury leave) will be contingent upon the initial and continuing funding for the wellness programs. It will be limited by the fire department's ability to fund the policy. Continual funding may also be impacted as these initiatives may be considered a luxury that the city cannot afford during periods of financial crisis.

Data collection and tracking will be vital in the success of the program. Honest and thorough data collection must be maintained to evaluate the progress of the program.

The city administration's interest in continuing its funding may be contingent on seeing the results of the program to ensure it is effectively reducing injuries, illnesses, and detecting life altering health conditions early.

2. Implementation Strategy

To implement these strategies successfully, the fire chief must have the support of the city manager's office, fire department command staff, and other key stakeholders. The city manager provides the authorization and support for implementing new policies; simultaneously, the command staff works on the details of the implementation strategy to ensure a smooth transition. Other key stakeholders must be considered in the support and planning of the new policies. These stakeholders include members of human resources, the law department, and the local bargaining unit (if applicable). While human resources and the law department vet the new policies to prevent labor law violations, the local bargaining group, and specifically, its executive board, can successfully garner support from the rank-and-file members of the department for the new and innovative policies.

The rank-and-file firefighters within the DFD are considered interchangeable during the planning and implementation phases of new policy rollouts. Alone, a firefighter will not significantly impact the rollout of the new policies. However, the rank-and-file firefighters comprise the vast majority of the personnel directly impacted by the work schedule, and health and wellness changes. Although they may not be involved in the decision making or implementation of new policies, the rank-and-file members must be receptive to the new policies and recognize their value. Work schedule changes and wellness programs can be valuable by meeting employee social, emotional, psychological, and medical needs. The rank-and-file must be shown how these policy changes will improve employee quality of life, as well as positively impact their lifestyle, leisure, and health.

Fire management must achieve support from the local bargaining unit's executive board; their support is crucial to garnering the support of the rank-and-file. The union executive board is tasked by the rank-and-file membership to protect its interests and work conditions consistent with the current labor agreement.

Within the union, a culture of brotherhood exists that offers a sense of trust within the membership; fire administration, while always striving to improve fire department efficiency and effectiveness, does not always share in this trust. While serving its roles as influencers, the executive board is pivotal in educating the membership on the value of the new policies. By influencing the rank-and-file members on the policy changes, and cooperating with the fire management in the policy implementation, the executive board achieves self-realization by enhancing work conditions for the membership.

The local bargaining group, in its roles as influencers, also has the political wherewithal to meet with the local elected body; i.e., the Dayton City Commissioners, to lobby for their interests. Thus, if successfully lobbied, the City Commission can encourage the City Manager to support its position also. Therefore, the executive board plays an integral role in seeing that the new policies are properly supported. It will be incumbent upon the fire management to seek the support of the executive board early in the planning process.

The essentials for the implementation of the policy changes will be the DFD chief, assistant chiefs, and the City Manager's Office (CMO). The city manager and staff run the day-to-day affairs of the City of Dayton and it is imperative that they are briefed on potential policy changes. The city manager and staff will have to be thoroughly briefed on the new policies, and particularly, the wellness program. This policy implementation will take substantial start-up funding authorization from city management, and without it, will likely not be implemented.

Including the CMO early in the planning phases facilitates communication, and smoothes the path for their acceptance. Early involvement also identifies conflicts deemed to be problematic for policy implementation. More importantly, it provides the DFD staff an opportunity to illustrate how the policy changes will help meet the needs of the city; i.e., a higher level of service without a corresponding increase in budgetary dollars. It also offers the city manager the ability to brief the elected body so it will be prepared to respond appropriately to the concerns of its constituents.

C. OPPORTUNITIES AND NEEDS FOR FUTURE RESEARCH

It was stated that the 48/96 work schedule improved an employee's mental and emotional condition. It is unclear whether this improvement will reduce sick and injury leave rates. More research may be valuable in determining if this schedule can be effective in reducing nonproductive time related to mental and emotional stressors.

It may also be valuable to determine if mitigating mental and emotional stressors can reduce cardiac-related firefighter deaths. Cardiac events are the number one reason for firefighter deaths at structure fire incidents; therefore, the 48/96 schedule's ability to reduce stressors may be effective in lowering firefighter death rates.

Research may be valuable in evaluating how often physical assessments should be performed on DFD personnel. Some resources call for annual assessments for all personnel, and some call for annual testing after an employee reaches a specified age. The assessments are the most expensive component of wellness programs, and depending on how often they are to be performed, their expense may affect the continuing funding for the program.

Further research is needed to evaluate whether a limited three-person staffing can be a viable policy option for the DFD. Three-person staffing can be implemented at fire companies that traditionally have slower run volumes. Targeting three to four fire companies for three-person staffing can potentially provide enough personnel to staff and additional fire apparatus. Furthermore, limiting this implementation to slower fire companies mitigates the risk of raising injury rates. Although minimum staffing is an article in the current CBA, the DFD and the bargaining group could negotiate a memorandum-of-understanding to allow a pilot project to test its results.

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